Changing grey–white back to red–white

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When meeting someone for the first time, a dental technician or dentist automatically glances at the person’s mouth and teeth. Generally, the unnatural grey- or purple-coloured gingiva attracts more attention than the quality of the crowns. As detailed in the following case report, anterior porcelain-fused-to-metal (PFM) crowns or bridges are the main reason for this unsightly gingiva.

Case report

A female patient came to our office in February 2012 complaining about pain in the region of teeth 22 and 23. In addition, she was unhappy about the grey colour of her maxillary gingiva and enquired whether it could be addressed. Teeth 13–23 had been restored with PFM single crowns 15 years before (Figs. 1–3).

After a detailed discussion of the state of the art in anterior aesthetics, we decided to renew all six PFM crowns and replace them with IPS e.max crowns (Vivadent Vivadent). For all anterior cases, IPS e.max is our first choice of material. Not even all ceramic is all ceramic. Zirconium has nearly the same light transmission as PFM—almost nothing. Of course development goes on, and the first translucent zirconia products have been made available. It is first necessary to understand what causes a grey-coloured ridge in patients provided with PFM crowns.

There are two principal reasons. The first is the umbrella effect. This appears only with PFM and sometimes with zirconium crowns. The opaque copings block the light (Figs. 4a & b), so the root is not able to transmit the light and brighten up the papilla from the inside. Lithium disilicate glass-ceramic (except for the MO and HO ingots) is able to mimic the natural tooth. Owing to the mineral (crystal-line) structure of the tooth substance and the natural light transmission of the IPS e.max restoration, the light is scattered in all directions inside the tooth, lighting up the gingiva from the inside (Figs. 4c & d). The second reason for grey gingiva underneath PFM crowns is metal oxides diffusing into the soft tissue. The possibility of dark gingiva is increased by crowns with a higher ignoble metal content.

Treatment plan

After preparing all the necessary paperwork and discussing the treatment plan again, we began removing the old crowns and finished the supragingival preparation in the middle of April. The stump shade of all six teeth was the same, allowing us to press the copings all at once in the same shade (IPS e.max Press LT A2; Figs. 5 & 6).

The provisional was directly prepared (IPS e.max Press LT A2; Figs. 5 & 6). For the preparation we decided to renew all six PFM crowns and finished the supra-gingival preparation in the middle of April. The stump shade of all six teeth was the same, allowing us to press the copings all at once in the same shade (IPS e.max Press LT A2; Figs. 5 & 6). The provisional was directly prepared in the office. It is important to leave enough space for the papillae so that they are not pushed away (Figs. 7 & 8).

After taking the impressions using Aquasil Ultra (DENTSPLY; Fig. 9), the model work was performed (Figs. 10 & 11) and the IPS e.max copings were prepared (Fig. 12). For the pressing process, we used Vario Press 300 e (Ziitler). The extremely short pressing time results in a very thin reaction layer. There is therefore no need to etch the item in hydrofluoric acid. The advantage is the perfect fit achieved because the thin margins of the copings are not rounded by
Implant failure may be related to bisphosphonate use

NEW YORK CITY, NY, USA:
The results of a study conducted at the New York University College of Dentistry seem to confirm the hypothesis that the use of oral bisphosphonate is connected to dental implant failure. In the case-control study, more than 300 middle-aged female patients with failed dental implants were compared with women from the same age group whose implants were still intact.

Clinical evaluations at the Department of Periodontology and Implant Dentistry were conducted between 1997 and late 2004. According to the researchers, the clinical data gathered from these examinations showed that in women whose implants had failed the odds of having taken bisphosphonate orally were almost three times higher. Dental implant failure related to the use of oral bisphosphonate also seemed to be more likely to occur in the maxilla.

Neither the quantity nor the duration of bisphosphonate use was evaluated.

Although the risk of implant failure is low, the researchers concluded that oral bisphosphonate could pose a risk to the success of dental implant therapy and should be prescribed with caution.

Earlier research on the association between bisphosphonate use and implant failure when bisphosphonate was taken by patients before or after implant placement.

However, the majority of clinical organisations still recommend that long-term users stop taking bisphosphonate before undergoing dental implant procedures to avoid complications.
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Ceramics: Rationale for material selection

Introduction
Many types of ceramic materials and processing techniques have been introduced throughout the years. As early as 1903, Charles Land patented all-ceramic restorations, using fired porcelains for inlays, onlays and crowns. Insufficient understanding of material requirements for survival in the oral environment, poor ceramic processing techniques, and the inability of adhesive cementation led to early catastrophic failure. Since then, all imaginable varieties of materials and techniques, from very conserva- tive ceramic restorations to very complex porcelain veneered of either metal or high-strength crystalline ceramics, have been introduced and tried with varying levels of success. The authors have previously published two detailed descriptions of a classification systems for ceramics used in dentistry, one based on the microstructure of the material and the second based on how in which the mate- rial is processed. There is considerable misinformation about the lack of rational treatment planning guidelines published regarding the use of different ceramics in dentistry. The literature is rich and vast with few inconsistent reports of clinical success and failures of all types of dental treatments. Sadowsky published a review of the literature covering treatment considerations using aesthetic materials, for example whether to use amalgam or composite and the success rates of different treat- ments. No recent literature could be found presenting a thorough discus- sion of when to use the various cera- mics, for example when e.g. feldspathic porcelain should be used, when ei- ther pressed or machined glass-cera- mics are appropriate, when different types of glass-ceramics should be employed, when a high-strength al- ternative crown system of either alu- mina or zirconia is ideal, and when metal ceramics are suitable.

This article provides a systema- tic stepwise process for treatment planning with ceramic materials and presents specific guidelines for the appropriate clinical conditions for ap- plications of the various systems.

Treatment philosophy
A treatment philosophy based on cur- rent standards of care that consider the patient’s aesthetic requirements and is a prerequisite to making any deci- sion regarding the use of a material or technique. More importantly, this philosophy should be aimed at main- taining the long-term biological and structural health of the patient in the least destructive way.

Restorative or aesthetic dentistry should be practised as conservati- vely as possible. The use of adhe- sive techniques to bond to (and preserve as much tooth structure as feasible while satisfying the patient’s restorative needs and aesthetic desi- res. The philosophy today is not to remove any healthy tooth structure unless absolutely necessary. This will reduce dentists’ frustration when or- thodontics would have been the ideal treatment. With restorations, clini- cians should choose a material and technique that allows the most con- servative treatment in order to satisfy the patient’s aesthetics, structural, and biological requirements, and that me- ets the mechanical requirements to provide clinical durability. Each of these requirements could be the topics of individual articles.

There are four broad categories or types of ceramic systems: 1. Powder/liquid feldspathic porcelains; 2. Pressed or machined glass-ceramics; 3. High-strength crystalline ceramics; and 4. Metal ceramics.

Category 1
Porcelains—the most translucent— can be used the most conservatively, but are the weakest.1, 4

Category 2
Glass-ceramics can be very translu- cent too but require slightly thicker dimensions for workability and aesthetics than porcelains do.

Categories 3 and 4
High-strength crystalline ceramics and metal ceramics, although demon- strating progressively higher fracture resistance, are more opaque and, there- fore, require additional tooth reduc- tion and are thus a less conservative alternative.

Based on the treatment goal of being as conservative as possible, the first choice will always be porce- lains, then glass-ceramics, followed by high-strength ceramics or metal ceramics. The decision will be based on satisfying all the treatment requi- rements, that is, if the more conserva- tive material meets all the treatment requirements then that is the ideal choice. The article will identify the clinical conditions in which treatment requirements dictate the use of a spe- cific category of ceramics.

Space required for aesthetics
The first consideration is the final 3-D position of the tooth, that is, smile design. There are several resources available for smile design.5, 9 The second consideration is the colour change desired to the substrate (i.e., tooth), since this will dictate the restoration thickness. In general with porcelains, a porcelain thickness of 0.2–0.3 mm is required for each shade change (A2 to A1 or 2M1 to 1M1). For example, A3 to A0 would require a veneer of 0.6–0.9 mm in thickness.

Glass-ceramics have the same space requirements as porcelain for effective shade change; however, the authors find it difficult to work with this category and produce the best aesthetic results when the material is less than 0.8 mm in thickness. High- strength all-ceramic crowns require a thickness of 1.2–1.5 mm, depending on the substrate colour, and metal ce- ramics need a thickness of at least 1.5 mm to create lifelike aesthetics. With that in mind, a diagnosis based on to- oth position and colour change will direct treatment planning, as well as the final decision regarding tooth pre- paration design (i.e., total tooth struc- ture restorations versus crown). Orthodontic treatment is required to facilitate a more conservative and ae- sthetic outcome.

Clinical parameters to evaluate
Once the 3-D smile design has been completed, colour change assessed, and adjunctive therapy finished to create an environment that will al- low the least removal of healthy tooth structure, an evaluation of each tooth is needed for ascertaining which ce- ramic system and technique are most suitable. The evaluation of individual teeth for specific material selection involves assessing four environmen- tal conditions in which the restoration will function.

Substrate
The first consideration is evaluating the substrate to which the material will be attached (Fig. 1). Is it enamel? How much of the bonded surface will be enamel? How much enamel is on the tooth? Is it dentine? How much of the bonded surface will be dentine? What type of dentine will the resto- ration be bonded to (tertiary or sclero- dentine exhibits a very poor bond to this type of dentine and the patient’s oral condition is reasonably healthy.

Medium risk when signs of occlus- al trauma are present; mild to mod- erate gingival recession exists, with inflammation; bonding mostly to enamel is still possible; and there are no excessive fractures.

High risk when there is evidence of occlusal trauma from parafunction; more than 50% of dentine exposure exists; there is significant loss of en-amel due to wear of 50% or more; and porcelain must be built up by more than 2 mm.

Bond/seal maintenance risk assess-
ment
The fourth parameter is the risk of losing the bond or seal of the resto- ration to the tooth over time. Glass- matrix materials, which consist of the weaker powder/lidet porcelains, and the tougher pressed or machined glass-ceramics, require maintenance of the bond and seal for clinical du- rability.11, 12 Owing to the nature of the glass-matrix materials and the absen- ce of a core material, the veneering porcelains are much more suscepti- ble to fracture under mechanical stresses and, therefore, a good bond in combination with a stiffl tooth structure (e.g., enamel) is essential for reinforcing the restoration. If the bond and seal cannot be maintained, then high-strength ceramics or metal ceramics are the most suitable, since these materials can be placed using conventional cementation techniques.

Clinical situations in which the risk of bond failure is higher are:

• Moisture control problems;
• Tooth that has undergone extensive loss on bonded interfaces;
• Variable bonding interfaces (e.g. different types of dentine);
• Material and technique selection of bonding agents (i.e., as dictated by such clinical situations as inability to achieve proper isolation for mic- rowax or technique selection of adhe- sive technology); and
• The experience of the operator (Fig. 4).

Excessive shear and tensile stress risk assess-
ment
The third parameter is the risk (or amount) of ongoing shear and ten- sile stresses that the restoration will undergo due to the contact forces and are more guarded for specific materials. All types of ceramics (especially porce- lains) are weak in tensile and shear strength, therefore the worst failures occur best under compressive stress. If the stresses can be controlled, then wea- ker ceramics can be used, for example fused porcelain in the tooth.

The same parameters are evaluated, simi- lar to flexure risk, for example deep overbites and potentially large areas where the ceramic would be cantilev- ered (Fig. 3).

If a high-stress field is anticipated, stronger and tougher ceramics are needed; if porcelain is used as the aesthetic material, the restoration de- sign should be engineered with such support (usually in a similar way to the core) so that it will redirect shear and tensile stress patterns to com- pression. In order to achieve that, the practitioners must ensure the veneering porcelain by utilising the reinforced-porcelain system tech- nique, which is generally accepted in the literature as a metal ceramic concept.10 The practitioner can assess and categorise low, medium, or high risk for tensile and shear stresses ba- sed on the restorative materials and symptoms mentioned above.

Bond/metal interface risk assess-
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• The experience of the operator (Fig. 4).

An assignment of low, medium, or high risk for bond failure would be as follows:

• Moisture control problems;
• Tooth that has undergone extensive loss on bonded interfaces;
• Variable bonding interfaces (e.g. different types of dentine);
• Material and technique selection of bonding agents (i.e., as dictated by such clinical situations as inability to achieve proper isolation for mic- rowax or technique selection of adhe- sive technology); and
• The experience of the operator (Fig. 4).

Assignment of low, medium, or...
high risk for bond and seal failure is based on the evaluated parameters.

Category 1: Powder/liquid porcelains

Guidelines: Bonded pure-porcelain restorations are ideal as the most-conservative choice but are the weakest material and require specific clinical parameters to be successful.13 Many good materials and techniques are available for bonded porcelain (e.g., Creation, Jensen Dental; Ceramco; 3, DENTSPLY, EX-3, Noritake). However, VITA VM 13 (VITA Zahnfabrik) is recommended by the authors when observing 3D-Master shade is taken, and Visio- tage Halo (SHOFU) when classic shades are taken.

When following clinical parameters and guidelines at the University of California, Los Angeles’s Center for Esthetic Dentistry (UCLA Center for Esthetic Dentistry), these materials have been used with similar success rates compared with porcelain fused to metal (i.e., less than a 9% fracture rate if all parameters are followed, unpublished data, Figs. 5 & 6).

Aesthetic factors

Space requirements for shade change: 0.2 – 0.3 mm is required for each shade change.

Environmental factors

1. Substrate condition: There is 50% or more remaining enamel on the tooth, 50% or more of the bonded substrate is enamel, and 30% or more of the margin is in dentine. It is important to note that these percentages are subjective assessments based on an overall evaluation of all parameters affecting the tooth to be restored and which may influence material selection. If bonding to some dentine substrate, the dentine should be mostly unaffected and superficial, since sclerotic dentine exhibits a very poor bond strength.

2. Flexure risk assessment: There is a higher risk and a more guarded prognosis when bonding to dentine. Owing to dentine’s flexible nature, it is recommended that restorations with low fracture resistance materials be avoided and, therefore, the presence of a higher percentage (i.e., at least 70% in high-stress area as such as the margins of enamel) is recommended when restoring using powder/liquid porcelains (Category 1) materials. By increasing the presence of enamel, the prognosis is improved and, therefore, the duration of the flexural stress ratio, the risk can be assessed as low to moderate.

3. Tensile and shear stress risk assessment: There is a low to low/moderate risk. Large areas of unsupported porcelain, deep overbite or overlap of bonding, to more flexible substrates (e.g., dentine and composite), bruxing, and more significantly placed restorations increase the risk of exposure to shear and tensile stresses.

4. Bond/seal maintenance risk assessment: There is an absolute low risk of bond/seal failure.

Summary: Porcelains are generally indicated for anterior teeth. Occasional buccal use and rare molar use would be acceptable only with all parameters at the least risk level.

Category 1 materials are ideal in cases with significant enamel on the tooth, and generally with low flexure and stress risk assessment. These materials require long-term bond maintenance for success.

Category 2: Glass-based pressed or machinable materials

Guidelines: Glass-ceramic pressable materials, for example IPS Empress (Ivoclar Vivadent) and Authentic (Jenson) and the higher-strength IPS e.max materials (Vocal Vivadent), can be used in any of the same clinical situations as Category 1 materials. Machinable versions of glass-ceramic material, for example VITABLOCS Mark II (VITA Zahnfabrik), IPS Empress CAD (Vocal Vivadent), and IPS e.max CAD, can be used interchangeably with the pressed versions. Monolithic IPS e.max, owing to its high strength and fracture toughness, has shown promise as a full-contour, full-crown alternative, even on molars.13

Glass-ceramics can also be used in clinical situations when higher risk factors are involved. Other than certain risk factors (see below) that would limit their use, these materials can be used in a thin margin, and the presence of sufficient room to achieve the desired aesthetics.

Aesthetic factors

Space requirements for workability and shade change: A minimum working thickness of 0.8 mm and 0.2 – 0.3 mm for each shade change is required.

Environmental factors

1. Substrate condition: There is less than 50% of the enamel on the tooth, less than 50% of the bonded substrate is enamel, and 30% or more of the margin is in dentine.

2. Flexure risk assessment: The risk is medium for Empress, VITA-BLOCS Mark II and Authentic-type glass-ceramics, and layered IPS e.max. In cases in which flexure is medium to high (and full-crown preparation is not desirable) the authors have found in their clinical trials that monolithic IPS e.max has been 100% successful for as long as 30 months in service. All glass-ceramic restorations, including IPS e.max, were adhesively bonded in their studies.

3. Tensile and shear stress risk assessment: The risk is medium for Empress, VITABLOCS Mark II and Authentic-type glass-ceramics, and layered IPS e.max. It is medium to high for bonded monolithic IPS e.max.

4. Bond/seal maintenance risk assessment: There is a low risk of bond/seal failure for Empress, VITABLOCS Mark II and Authentic-type glass-ceramics, and layered IPS e.max. It is medium for monolithic IPS e.max.

Summary: Pressed or machined glass-ceramic materials, such as Empress, VITABLOCS Mark II, and Authentic are indicated for thicker veneers, anterior crowns, and posterior inlay and onlays (Figs. 7 & 8) in which medium or less, flexure, and shear and tensile stress risk is documented (Figs. 9 & 10). Also, they are only indicated in clinical situations in which long-term bond and seal can be maintained. IPS e.max (Figs. 11 & 12), which is a different type of glass-ceramic that has higher toughness, is also indicated for the same clinical situations as the other glass-ceramics, but can be extended for single-tooth use in higher-stress situations (as in molar crowns). This is provided it is used in a full-contour monolithic form and cemented with a resin cement.

Category 3: High-strength crystalline ceramics

Guidelines: Mostly, (e.g., VITA In-Ceram, VITA Zahnfabrik) all-crystalline materials are used for core systems to replace metal that would then be veneered with porcelain. Alumina-based systems, for example In-Ceram and No- bellCorona ( Nobel Biocare), were first on the market but are now generally being replaced with zirconia systems. Alumina systems have shown to be very clinically successful for single units, with a slightly increased risk in the molar region.13,14 They can be recommended for any single-unit anterior or buccapulpic crown (Figs. 13 & 14). The authors have observed a slight increase in failure in conventional cements. For example, after using alumina restorations for many years at the UCLA Center for Esthetic Dentistry, the authors observed that at eight and ten years, the failure rate doubled to approximately 2%, with those failures being core fractures necessitating replacement (unpublished data). Their suggestion for alumina-core restorations is either a reoptimized glass ionomer luting cement (e.g., RelinX, 3M ESPE) or a resin cement. For zirconia-core systems (e.g., LAVA, 3M ESPE), the authors have not experienced core fractures but have seen problems with chipping of porcelain. White and McLaren15 found that a slow-heat slowcool thermal cycle minimizes the stress in the porcel inet and at the porcelain/zirconia interface. Clinically, since the authors of this current article have been using the altered firing schedules, their replacement rate for shipping has been reduced by less than 1%.

Aesthetic factors

Space requirements for workability and maximum aesthetics: A minimum working thickness of 1.2 mm is required, and 1.5 mm is ideal if ma- sking.

Category 3 materials are indicated with a resin cement (e.g., RelyX, 3M ESPE) or a resinmodified glass ionomer luting cement (e.g., RelinX, 3M ESPE) or a resin cement. For zirconia-core systems (e.g., LAVA, 3M ESPE), the authors have not experienced core fractures but have seen problems with chipping of porcelain. White and McLaren15 found that a slow-heat slowcool thermal cycle minimizes the stress in the porcelain and at the porcelain/zirconia interface. Clinically, since the authors of this current article have been using the altered firing schedules, their replacement rate for shipping has been reduced by less than 1%.

Environmental factors

1. Substrate condition: Substrate is not critical, as high-strength core supports veneering material.

2. Flexure risk assessment: The risk is high or below. For high-risk situations, core design and structural support for porcelain become more critical.

3. Tensile and shear stress risk assessment: The risk is high or below. Note that for high-risk situations, core design and structural support for porcelain become more critical. Preparations should allow for a 0.5 mm core plus 1 mm of porcelain to ensure the best aesthetic results. Additionally, there should not be more than 2 mm of unsupported occlusal or incisal porcelain. The restoration core should be built out to support marginal ridges.

4. Higher-risk molar regions, it is better to use zirconia cores rather than alumina cores, provided the current firing parameters are followed. Full-contour zirconia restorations (e.g., BrosZir, Glidewell Labora- tories) have been recommended for highrisk molar situations. Failure of these restorations is not likely to be an issue; some preliminary concern involves wear of the opposing dentition with full-contour zirconia.2 No clinical data could be found to confirm or refute this. Clinically, only full-contour zirconia against full-contour zirconia in the molar region should be considered when no other clinical option is viable.

5. Bond/seal maintenance risk assessment: If the risk of obtaining or losing the bond or seal is high, then zirconia is the ideal all-ceramic to use.

Summary: A high-strength ceramic (specifically zirconia) is indicated when significant tooth structure is missing, unfavorable risk for flexure and stress distri-
cated, the CAPTEK (Precious Chemicals USA) system has been the material of choice at the UCLA Center for Esthetic Dentistry owing to its superior aesthetic properties. Aesthetic factors

1. Space requirements for workability: 1.5–1.7 mm is required for maximum aesthetics.
2. Substrate condition: The substrate is not as critical, since the metal core supports the veneering material.

The researchers hypothesized that even low levels of the drug can lower sperm count and negatively affect male fertility, an increasing problem worldwide. They suggested that a better understanding of the mechanism of these extratran proteins could help infertile men or aid the development of a nonhormonal contraceptive for men.

In addition, their experiments established that adding clofibrate, a drug prescribed for treating lipid disorders, such as high blood cholesterol and triglycerides, led to a blockage of the TAS1R3 receptor, leaving the mice without any functional TAS1R3 and GNAT3 protein. The mice then became sterile owing to malformed and fewer sperm. However, the condition could be reversed by removing clofibrate from the mice’s diet.

Some taste receptors have been found in testes and sperm as well. However, their function was unknown. Now, researchers have suggested that they affect sperm development and maturation. (Photo: FCGS/ Shutterstock)

Published by open-access publisher InTech. These include patch testing, which has to be conducted over several days and is considered inaccurate because it is subject to the experience and knowledge of the examining person.

In a comparison test conducted by several members of the research team in 2010, RCLM demonstrated advantages over patch testing for visualising features of allergic contact dermatitis due to nickel and cobalt, two substances that have been found to cause the highest incidence of allergies in dental patients in addition to chrome, palladium, gold, and silver.

“While it might become a real-time diagnostic or adjunctive tool to identify a suspicious lesion or to delineate cancerous margins”, RCLM still has limitations, such as the inability to detect deep objects in the dermis of normal skin, the researchers stated in the report. In addition, a thick stratum corneum and vesicle formation can restrict visualisation. In order to distinguish between different cells and determine pathological characteristics better, higher and better contrast is needed for these devices, they recommended.

Contact Info
Prof. Edward A. McLaren, DDS, MDC, is the founder and director of UCLA postgraduate aesthetics, and Director of the UCLA Center for Esthetic Dentistry in Los Angeles, California.
Yair Y. Whiteman, DMD, is a full-time faculty member at the UCLA Center for Esthetic Dentistry.

Figure 15: Pre-op image of old FPM. The patient was unhappy with the opacity and material display at margin. Category 3 or 4 material is required for this case.

Figure 16: Post-op image of a LAVA coping with the new LAVA Digital Veneering System (3M ESPE).

Figure 17: Post-op image of teeth 18 and 20 in a case with subgingival margins and poor bonding. Metal ceramics with a coping (CAPTEK).

Summary
Metal ceramics are indicated in all full-crown situations, esp. when any risk factors are high (Fig. 17).

Conclusion
This article has presented a systematic process of clinical evaluation and rationale for material selection. The most important point is that the most-conservative restoration should be done if the clinical criteria are met; for example, a full-coverage crown or deep-cut glass-ceramic restoration should not be performed when a more conservative porcelain restoration is indicated.