

PREP DESIGN AND CHOICE OF MATERIALS, A LAB PERSPECTIVE ©

First, we divide the subject into two major categories:

- 1) Amount of Reduction.
- 2) Margin finishing.

When it comes to *Reduction*, one has to first decide what kind of restoration to put on the tooth:

- a) *Core Supported* Full Coverage crown (e.g. PFM or Zirconia, etc.)
- b) *Core Free* Facial Laminate, $\frac{3}{4}$ Crown or Full crown (e.g. Pressed Lithium Disilicate, e.Max)

There are, of course, several inter-related factors that come into play when deciding between core supported or core free. The major ones are:

1. How much reduction is necessary to achieve my goal?
 - a) In most cases, if you must reduce facial more than 1.0mm, then a core supported restoration is preferable.
 - b) If you can get away with reducing facial less than 1.0 mm (and there are no other contra-indicators) a translucent core free material (e.g. e.Max) will generally deliver better aesthetic results.
2. After reduction, how much *un-supported* ceramic will I have in functional areas like cusp tips and incisal edges?
 - a) In general, a translucent Core Free restoration is functionally safe with less than 2.0mm of un-supported porcelain. However, it also depends on the thickness of the porcelain in the unsupported area. E.g. a very thin incisal edge may very well be unsafe even if the amount of un-supported porcelain is less than 2.0mm.
 - b) If there is more than 2.0mm from the prep to the final shape of the restoration, then the restoration usually requires a core (metal or zirconia) so that internal support can be built into the restoration.
3. After reduction, how much enamel is left to bond to?
 - a) Translucent Core Free restorations requires full resin bonding to achieve optimal strength, and it is a lot more predictable to bond to enamel than to bond to dentine (or other). The most critical area where enamel must be present is all around the margin.
 - b) Core Supported restorations can be conventionally cemented onto enamel, dentine, metal, or zirconia, and do not require enamel bonding.
4. Ease of cementation?
 - a) Full Resin Bonding (Core Free Restorations) is technique sensitive.
 - b) Conventional cementation (Core Supported Restorations) is easier by comparison.
5. How much "blocking power" (of the underlying stump shade) do I need to achieve the desired final shade?

- a) If the needed “blocking power” is less than 20% (i.e. One Shade Grade), then a 0.5 – 1.0 mm Translucent Core Free Restoration (e.g. e.Max) is safe. For example, to shift the shade from an A2 to an A1 is about 15%. You can do that quite easily with a normal, naturally translucent, Core Free Restoration.
- b) If the needed “blocking power” is more than 20%, then you need an opacous or opaque core to help with “blocking”:
 - i. e.Max 0.5 mm = 10% blockage (at least 0.5 mm reduction required)
 - ii. e.Max 1.0 mm = 20% blockage (at least 1.0 mm reduction required)
 - iii. Zirconia 0.5 mm = 50% blockage (at least 1.5 mm reduction required)
 - iv. Zirconia 1.0 mm = 70% blockage (at least 1.5 mm reduction required)
 - v. PFM +0.3 mm = 100% blockage (at least 1.5 mm reduction required)
- c) What’s important to remember here is this: the natural translucency of the so called “aesthetic” ceramic materials (e.g. e.Max, Zirconia Copings, etc.) are only advantageous if they can take advantage of a naturally translucent, tooth colored stump. A Translucent Restoration is nothing more than a filter. For example, when you look at a nice e.Max restoration, you do not see only the e.Max material, what you see is how the e.Max material *optically interacts with the underlying stump*. The stump is an integral and crucial part of the final appearance. If the stump is discoloured, then the natural translucency of the all-ceramic material is not an advantage but a liability. It is important to remember that the recording of stump color is not for compensation, but so that a suitable material can be selected, and the appropriate amount of reduction determined. For example: If the stump is dark, then you must block the darkness with something. Many times, it is much better to block 100% with 0.3 mm of metal... thereby leaving yourself maximum space for developing the *illusion* of translucency. In other words, it’s not the materials that are “aesthetic” or “un-aesthetic”. It’s the communication, co-operation, and skills of the dentist/technician team, and their understanding of the materials they work with, that leads to aesthetic or un-aesthetic results.

Special considerations regarding e.Max and other highly translucent restorative materials:

Any veneer material (e.Max included) is, as mentioned before, nothing more than a filter. Because of this inevitable filter effect, there are two major concerns that we must work around and creatively anticipate:

- 1) E.Max restorations relies on the underlying tooth for both strength and color support. Even if we have been provided with stump shades from the dentist we cannot predict 100% what the restoration will look like when it goes in the mouth. We are always guessing. For this reason, technicians prefer the stump shade as close as possible to the desired shade, and never more than 1 shade removed from the desired shade. If the stump is more than one shade darker, the dentist should seriously think about NOT using e.Max, since it is quite likely that final shade issues will be a major problem. For example: if the desired shade is 1M1, it will be ok if the stump is 2M1, 2M2, 2M3 or lighter, but not if the stump is 3M1 or darker.
- 2) On all veneering materials, there is a slight color-shift that takes place after bonding. Predicting this color-shift is almost impossible because the same bonding cement may very well shift differently in different people. The only thing that is predictable when it comes to color-shift, is that we know – from scientific studies – that Dual Cure type bonding materials (e.g. “Panavia V5”), have much higher color-shift than if you are using a full resin bonding protocol (e.g. “Variolink Veneer”).

Since technicians cannot put veneers in the patients’ mouths, you cannot expect technicians to be predictably successful in compensating for underlying darkness on veneer cases. There is simply no way for technicians to test whether it works when the veneers are sitting on a model. Technicians do the best they can with the information they have, but the final testing of color parity can only be done in the mouth

by the dentist and must be done with the underlying bonding agent. Dentists can order bonding agents and try-in pastes in different translucencies to do such testing. For example, “Variolink Veneer” is available in seven different translucencies and colors, both try-in pastes and the actual bonding material. This will give the dentist the best chance of getting an accurate color match.

Finally, for the manufacturing of veneers, it is always better to err a little on the bright side, because it is much easier to “tone it down” rather than brighten it up. Toning down, one can do with the bonding agent, or by returning the case to the lab for stain and glaze. Brightening up one can only do with the underlying bonding agent, but remember, only one shade brighter is generally possible.

Having now set the criteria for choosing between Translucent Core Free or Core Supported, we can now move on to determine the amount of reduction in each case. First though, it is important to remember that the required reductions mentioned below, should always be made from the *desired* tooth form (which is frequently NOT the *pre-operative* tooth form). Many times (if not most of the time) dental restorations, especially in the anterior, are made precisely because the patient needs or desires, not just a change of color, but also a change of the present tooth form. We want to move teeth in, out, close gaps, correct rotations and mis-angulations. The only way to precisely determine the amount of reduction from the desired tooth form is to make a wax-up, and subsequent provisionals, which probably will require test-driving and possible alterations, before a provisional result can be achieved that is both aesthetic and functional. The amount of final reduction is then determined from the provisionals, not from the pre-op situation. If we want to practice in the arena of “conservative” reductions, and deliver aesthetic core free restorations, and we also want to help patients with closing gaps, correct rotations and mis-angulations, we will need the help of an orthodontist to move teeth into favorable positions. Otherwise, we will have to choose to step into the arena of more heavy reduction and perhaps core supported restorations.

Translucent Core Free Restorations:

Ideally, teeth that are prepared for core free restorations should be prepared in such manner that they all have even reduction from the desired tooth form (provisional) and that all underlying stump-shades are roughly the same. Sometimes, if teeth are slightly misaligned, or rotated, or we desire to close gaps, or correct space distribution problems (moving midlines or contact points) this will require that we break contact points and/or prep over the incisal edges onto the palatal or lingual sides. The guidelines are as follows:

- 1) No change to original tooth form:
 - a. Break contact points: NO.
 - b. Prep lingual/palatal: NO.
 - c. Incisal Reduction:
 - i. 1.0 mm: Simple shade structure (dentine/enamel like shade sample)
 - ii. 1.5 mm: Moderate shade structure (incisal translucency).
 - iii. 2.0 mm: Complex shade structure (internal mamelons, maverick colors, etc.)
 - d. Facial Reduction
 - i. 0.5 mm: Favorable stump colour (up to 25% darker)
 - ii. 0.5 – 1.0 mm: Slightly unfavorable stump colour (25% – 35% darker)
 - iii. If you must reduce more than 1.0 mm (+40% darker): consider a Core Supported Restoration. Chances are that you will not have enough enamel left to bond to anyway.
- 2) Moving incisal edges either facial or lingual/palatal (slight misangulation):
 - a. Break contact points: Only the part of the tooth that need to be moved (create a minimum of 1.00 mm gap).
 - b. Prep lingual/palatal: YES – as much as you need to move the edge. Remember, if you are moving an incisal edge palatally you need to “prep” on the lingual (i.e. create a margin) but there is no need to “reduce”. It is important to understand the difference.

- c. Incisal Reduction:
 - i. 1.0 mm: Simple shade structure (dentine/enamel like shade sample)
 - ii. 1.5 mm: Moderate shade structure (incisal translucency).
 - iii. 2.0 mm: Complex shade structure (internal mamelons, maverick colors, etc.)
 - d. Facial Reduction
 - i. 0.5 mm: Favorable stump colour (up to 25% darker)
 - ii. 0.5 – 1.0 mm: Slightly unfavorable stump colour (25% – 35% darker)
 - e. If you must reduce more than 1.0 mm (+40% darker): consider a Core Supported Restoration. Chances are the you will not have enough enamel left to bond to anyway.
- 3) Closing Gaps:
- a. Break contact points: All the way down to the gingiva and all the way to lingual wall! This is important to make it easy for your ceramist to close the gap without creating dreaded “black triangles” (create a minimum of 1.00 mm gap).
 - b. Prep lingual/palatal: NO – not necessary if you are not moving the incisal edge
 - c. Incisal Reduction:
 - i. 1.0 mm: Simple shade structure (dentine/enamel like shade sample)
 - ii. 1.5 mm: Moderate shade structure (incisal translucency).
 - iii. 2.0 mm: Complex shade structure (internal mamelons, maverick colors, etc.)
 - d. Facial Reduction
 - i. 0.5 mm: Favorable stump colour (up to 25% darker)
 - ii. 0.5 – 1.0 mm: Slightly unfavorable stump colour (25% – 35% darker)
 - e. If you must reduce more than 1.0 mm (+40% darker): consider a Core Supported Restoration. Chances are the you will not have enough enamel left to bond to anyway.
- 4) De-Rotating teeth:
- a. Break contact points: As much as you need to de-rotate (sometimes all the way down to the gingiva and all the way to lingual wall). Create a minimum of 1.00 mm gap.
 - b. Prep lingual/palatal: YES – as much as you need to de-rotate. Frequently, de-rotating teeth requires prepping on both facial and lingual. Remember, if you are moving an incisal edge, for example, palatally, you need to “prep” on the palatal (i.e. create a margin) but there is no need to “reduce”. It is important to understand the difference.
 - c. Incisal Reduction:
 - i. 1.0 mm: Simple shade structure (dentine/enamel like shade sample)
 - ii. 1.5 mm: Moderate shade structure (incisal translucency).
 - iii. 2.0 mm: Complex shade structure (internal mamelons, maverick colors, etc.)
 - d. Facial Reduction
 - i. 0.5 mm: Favorable stump colour (up to 20% darker – roughly ONE shade)
 - ii. 0.5 – 1.0 mm: Slightly unfavorable stump colour (20% – 25% darker).
 - e. If you must reduce more than 1.0 mm (+30% darker): consider a Core Supported Restoration. Chances are that you will not have enough enamel left to bond to anyway.
 - i. Zirconia 0.4 mm = 50% blockage (At least 1.2 mm reduction required)
 - ii. Zirconia 0.6 mm = 70% blockage (At least 1.5 mm reduction required)
 - iii. PFM +0.3 mm = 100% blockage (At least 1.5 mm reduction required)

Two more *reduction* considerations:

- 1) When finishing a prep (with *prep* I mean the internal walls of the coping... not the margin) that is designed to receive a *metal* coping, it may be to your advantage to create internal sharp edges (anti-

rotation grooves on short molars etc.). Metal is easy to wax and cast in sharp edges, and the edges will give you a firm and distinct *seating* of the restoration.

- 2) When finishing a prep (with *prep* I mean the internal walls of the coping, not the margin) that is designed to receive a ceramic core, or a core-free ceramic restoration, it is to your advantage to *round* all internal corners smoothly and evenly. This is because ceramic is never cast, but either pressed or milled, or stacked and all three are more accurate if finished around a rounded corner than around a sharp corner. That means you get more distinct seating of a ceramic restoration if the internal walls are rounded than if they are sharp. You will also avoid potential pressure points (on a sharp corner) that may induce cracking of the ceramic.

The only exception to ceramic and sharp corners is in the *margin* area. Ceramic is very strong in compression, but weak in tension. Therefore, at the margin, ceramic is strongest if finished to a flat and even 90 degree butt shoulder joint – i.e. an *external* sharp point. If the sharp corner is *external* it is easier to finish because the last finish can be ground and polished, not pressed or milled.

Margin Finishing:

The style of margin finishing depends on what material you plan to bring to the margin. We have three categories: Metal, Ceramic Core, and Core-Free Ceramic:

1) Metal

A metal margin is always the most accurate if finished to a bevel. Metal can be cast extremely thin (especially gold) and is pliable so therefore much easier to burnish if finished to a bevel. Metal bevel margins are the tightest and most accurate in dentistry. Metal finished to a shoulder margin is rarely accurate precisely because of the pliability of metal. Regardless of how accurate we can make the margin in casting wax, it is next to impossible to go through the whole manufacturing process (casting, finishing, porcelain applications, re-finishing and polishing) without touching the metal margin and because the metal is pliable, the edge sharp margin edge is easily lost.

2) Ceramic Core

A ceramic core (e.g. Alumina or Zirconia) cannot be milled as thin as metal, nor can it be burnished. Both Alumina and Zirconia are strong enough to adapt to a thin bevel joint but they are definitely at their strongest and most accurate if finished to a 0.5mm – 1.0mm chamfer or shoulder.

3) Core-Free Ceramic

As mentioned above, core-free ceramic is at its strongest if finished to a flat and even 90 degree butt shoulder joint. Ideally, the dimension of the shoulder should be 0.5mm – 1.0mm. A core-free ceramic bevel is extremely weak.