Point of Care

The "Point of Care" section answers everyday clinical questions by providing practical information that aims to be useful at the point of patient care. The responses reflect the opinions of the contributors and do not purport to set forth standards of care or clinical practice guidelines. This month's responses were provided by Dr. Asbjørn Jokstad, professor, head of prosthodontics, and Nobel Biocare chair in prosthodontics at the faculty of dentistry, University of Toronto.

QUESTION 1

What are some considerations to keep in mind if I want to start using full-ceramic restorations instead of metal–ceramics?

Background

Ceramic is second only to gold as the restorative material with the longest history of use in dentistry. However, this material is brittle and carries a well-known risk of fracture. Despite the documented risk, many dentists now wonder whether current research favours the use of the latest generations of full-ceramic restorations rather than metal–ceramic restorations.

Since 1960, when the porcelain-fused-to-gold technique was developed, new approaches have continually emerged, including ceramic reinforced with aluminum oxide or magnesium and aluminum, prefabricated ceramics, leucite-reinforced ceramic, and the lost-wax technique. Today, the zirconium oxide ceramics, introduced in 2001 for computer-aided design and computer-aided manufacture (CADCAM) of restorations, are regarded as "the ultimate in ceramics," and there is a wide spectrum of production possibilities, including traditional sintering, casting, pressing and infiltration (**Fig. 1**). Novel methods for machining prefabricated ceramic blocks are also being developed, and some high-strength ceramics have emerged. However, manufacturers' claims for the benefits of the newest ceramic products and techniques are usually based on extrapolation from laboratory and early clinical data, rather than solid long-term clinical data.

Metal–ceramic constructions can of course be esthetically pleasing, but the technician must be highly skilled in all aspects of the manufacturing process, especially the manual addition and subtraction of multiple layers of ceramic powders, and must be able to control dimensional changes during the process. This requirement also applies to full-ceramic constructions, for which these skills are even more critical. Therefore, any dentist who is considering a switch to the provision of full-ceramic restorations must take care in choosing a dental technician, although developments in the industry (specifically the creation of ceramic cores that fit well) have been an aid to the technician (**Fig. 2**). It is no coincidence that less than 10% of all full-ceramic constructions are now made from conventionally sintered ceramics.

One recent alternative to traditional metal–ceramic fixed partial dentures (FPDs) is the use of veneered and milled zirconium oxide substructures (**Fig. 3**), but concerns have been raised about microsurface damage introduced during the

Figure 1: Numerous new ceramics with different properties are available today for computer-aided design and computer-aided manufacture (CADCAM). The long-term performance of these ceramics remains unknown. (Product range of Vita GmbH, Germany.)

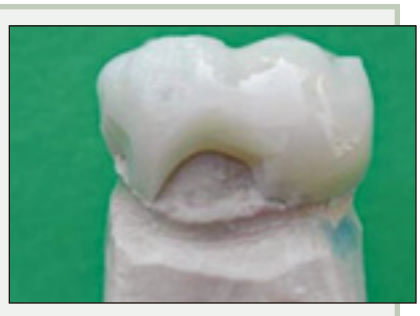

Figure 2: Ceramic materials are brittle and the fabrication of a well-fitting full-ceramic crown is technique-sensitive. Although CADCAM ceramic copings have improved fit compared to conventional sintered ceramics, great care must be applied in the try-in phase before cementation due to tension stress and the high-risk of fracture.

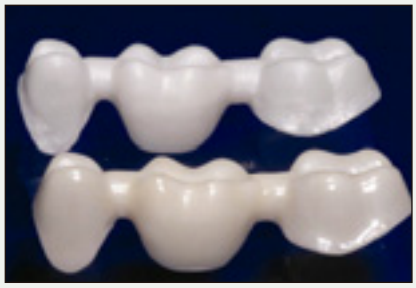

Figure 3: A CADCAM milled zirconium oxide substructure prepared to be veneered with conventional sintered ceramics.

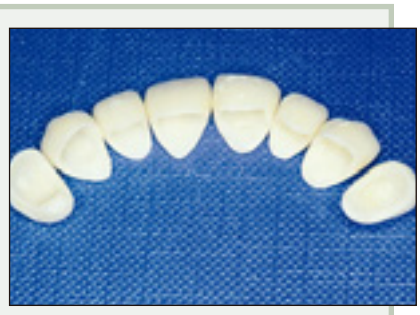

Figure 4: Single crowns made from pressable ceramics. Although esthetically pleasing, their longevity remains unknown.

CADCAM milling.[1] Moreover, small variations in the zirconia family of materials have been shown to cause dramatic and unexpected problems (e.g., with hip implants), and the initial enthusiasm for their use in medicine has been dampened. In dentistry, zirconium oxide implant abutments made by one company (3i) seem to function well, whereas another company (Astra) withdrew its first-generation zirconium oxide abutments and reintroduced another version in 2005. The long-term results with these implant abutments and zirconium oxide substructures are unknown.

Some Considerations in Choice and Preparation of Ceramic Restorations

A small proportion of dental patients have been persuaded that they should avoid having metals in their mouths for toxicological reasons. Although the dentist should explain that toxic effects are unlikely to occur, we must respect a patient's decision if he or she is determined to avoid metals. However, patients must also be made aware of the inadequacies of ceramic materials, which impose their own requirements on cavity and tooth preparations.

The strength of ceramic restorations depends on the support. The strength of a ceramic veneer cemented to etched enamel relates to the strength of the veneer itself in the same way that the strength of thin ice over concrete relates to the strength of thin ice over open water. Thus, if the ceramic restoration is not entirely supported by etched enamel, additional bulk is required because of inherent brittleness.

Full-ceramic FPDs should be considered only if there has already been a large loss of tooth substance and the work field is readily accessible; in this situation, one of the new high-strength CADCAM ceramics should be used.[2]

If the final restoration is to be made entirely of ceramic, more tooth tissue must be removed than would be the case if other biomaterials were used. This contravenes the modern restorative approach of minimal intervention. For single crowns, some full-ceramic systems do not require removal of additional tooth substance, but others do (**Fig. 4**).[1]

An essential element of prosthodontic care is a comprehensive evaluation of full mouth occlusion. The occlusion must be correct right from the start. Use full tray impressions and obtain the correct bite index for the retruded contact position. It is difficult to adjust the occlusion during the try-in before cementation, and surface polishing afterward will never achieve the degree of surface glaze that can be obtained directly by the dental technician. Furthermore, there is a tendency to forget to correct the occlusion and articulation before restoring single teeth, which may result in load concentrations that increase the risk of fracture with a full-ceramic restoration.

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QUESTION 2

What is the best luting cement for fixed prostheses?

Background

For more than a century, zinc phosphate cement has been the most common luting cement for retention of crowns and fixed partial dentures. Glass ionomer luting cements were introduced in the mid-1980s, and their longevity is comparable to that of zinc phosphate cement.[1] The subsequent incorporation of a resin into the polycarboxylate matrix of glass ionomer cements (in the mid-1990s) improved compressive and diametrical tensile strengths. It is generally assumed that improvements in physical and mechanical properties of the cement will reduce the risk of adverse clinical events and extend the longevity of fixed prostheses. However, longitudinal clinical data on the relevance of various cement properties to longevity are sparse, and for some products data are lacking entirely.[2,3]

Resin cements have better physical and mechanical properties, but their effectiveness is sensitive to technique, and an elaborate multistep procedure is needed for optimal cementation (**Fig. 1**).

The strong adhesion of the resin-modified glass ionomer cements to enamel and dentin and their fluoride release pattern suggest that these cements may have some cariostatic potential and resistance to marginal leakage. Both these and traditional glass ionomer cements are advocated on the basis of claims that the risk of caries is reduced. However, the notion that a particular cement may hinder caries in patients who cannot maintain adequate plaque control is flawed. Secondary caries develop on the enamel surface, not in the microgaps between the restoration and tooth, whether or not a fluoride-rich environment is present. Thus, it is difficult to understand how a luting cement can by itself provide protection against tooth demineralization.

The excellent track record of zinc phosphate cements suggests that the cement film along a well-fitting cast does not deteriorate with time (**Fig. 2**). Long-term observations of various cements will show if this is also the case for resin cements and resin-modified glass ionomer cements.

Considerations in Choice of Cement

For cementation of restorations that are limited to enamel surfaces, there are no options other than acid etching, bonding and use of a resin-based cement. The surface treatment of the restoration is equally important and will depend on whether the restoration is made of ceramic or electrolytically etched metal.

For cementation to a dentin surface, the choice is complicated by the type of restoration surface.

The inner surface of crowns made from conventional sintered ceramic must be treated with hydrofluoric acid to increase the surface area (**Fig. 3**). This should be done in the dental laboratory. It is advisable to re-etch the inner surface with ordinary phosphoric acid and to rinse well after completing the try-in and making any necessary adjustments. Subsequent silanization must be done immediately before cementation because of the uptake of humidity from the air, and a resin cement is required. The surface of the dentin must be treated according to the manufacturer's instructions.

If the inner surface consists of a reinforced ceramic (e.g., Procera [Nobel Biocare, Richmond Hill, Ont.] or InCeram [Vident, Brea, Calif.]), etching with hydrofluoric acid will not increase the

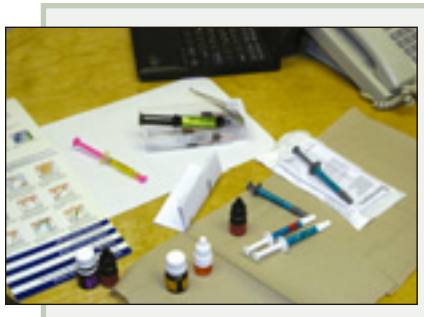

Figure 1: Armamentarium for cementation of the full-ceramic restoration. The cementation process is elaborate and technique-sensitive. Compliance with the manufacturer's instructions is required. Shelf life of the various components of the cement system varies; in most cases, it is less than 2 years.

Figure 2: The intact zinc phosphate cement on this 25-year-old bridge suggests that the cement film along a well-fitting cast does not deteriorate with time.

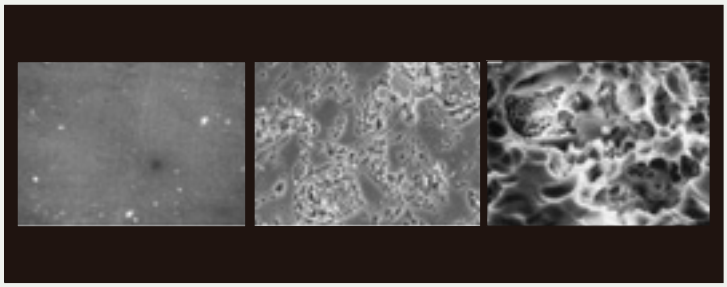

Figure 3: Treatment of conventionally sintered ceramic with hydrofluoric acid (HF) increases the surface area and thereby improves adhesion to the resin cement. Left: untreated ceramic; middle and right: surface appearance of ceramic after contact with HF.

Figure 4: Cementing the newest zirconium oxide ceramics with 4-methacryloxyethyl trimellitate anhydride (4-META) resin cements seems to give the best results.

surface area. Almost any cement type can be used, including a traditional water-based cement. For the newest zirconium oxide ceramics it appears that 4-methacryloxyethyl trimellitate anhydride (4-META) resin cements seem to give the best results (**Fig. 4**).

For all nonaqueous cements, the handling procedure varies from product to product, and it is therefore important to follow the manufacturer's instructions. Moreover, some components of these cements have a short shelf life, so the shelf life of each individual component must be checked.

In the hands of a gifted clinician, polycarboxylate cement is an excellent choice. However, near-perfect fit of the cast is required. Zinc phosphate cement is a little more forgiving, and glass ionomer cements are even more forgiving if there are inadequacies in marginal fit. There are no clinical data suggesting that conventional metal ceramics should not be fixed with these water-based cements.

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QUESTION 3

How can I obtain a perfect impression?

Background

In most situations, the dental practitioner can readily obtain an adequate impression, but dental laboratories often receive flawed impressions. Some studies from countries other than Canada (e.g., the United Kingdom[1]) indicate that the major problems associated with impressions relate not to the properties of the materials, but rather to a lack of attention to procedural details before, during and after the impression is taken.

Selection and Use of Impression Material

Avoid any impression material that does not comply with the standards set by the International Organization of Standardization (ISO) (**Fig. 1**). The manufacturer should provide information about compliance on the package. All of the products currently available in Canada exceed these standards in terms of accuracy and stability, and the small differences among brands are relatively unimportant. Do not deviate from the manufacturer's instructions for preparing the material. Although ad hoc "modified procedures" were common with more traditional materials, this approach is no longer acceptable. Manufacturers usually offer a product range based on one composition that has been modified to suit different purposes. The question of whether polyvinyl siloxanes should be preferred to polyethers or perhaps even reversible hydrocolloids cannot be answered definitively, because so many factors influence a clinician's choice of material; however, any material that is handled properly will give adequate results.[2]

Preparation of Field of Operation

If the operating field is not dry and accessible, no impression material will prevent the problems that are sure to occur, regardless of manufacturers' claims. There is no need to use adrenaline-impregnated cord in every situation, but aids for preparing a dry and accessible work field include other types of gingival cords, some of the newer gel types or pastes, plain cotton, and electrosurgery, radiosurgery or laser surgery; copper tubes may also have a place. Gingival cords may or may not be impregnated and can be obtained in twinned, braided or woven versions. These cords may contain one or more solutions including adrenaline; aluminum chloride; potassium, aluminum or iron sulphates; lignocaine; hydrochloric acid; and zinc phenol sulphonates. There is little research indicating which combination is best, so the clinician's subjective preference usually prevails.[3]

Selection of Tray for Application of Impression Material

The 2 most common types of problems in the dental laboratory relate to flexibility of trays and detachment of material from the tray (**Fig. 2**). These problems can be avoided by shunning cheap plastic trays and by coaching auxiliary staff to follow instructions for correct use of fixatives. The use of individual trays should be encouraged. Trays can be fabricated from a wide range of materials suitable for chemical polymerization, heat and light curing, or vacuum polymerization.

Technique for Application of Impression Material

Other problems encountered by the dental laboratory include drag in the impression, lack of definition of the finishing line and poor reproduction of details. The traditional problem of nonhomogeneous mixes, which tended to occur when materials were mixed by hand, can be avoided by using

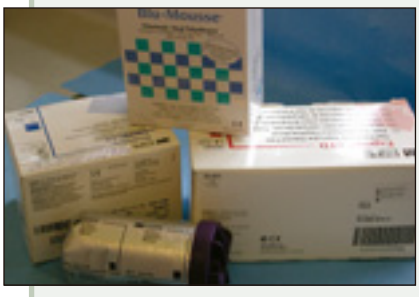

Figure 1: The CE marking on these packages indicate that the products comply with the standards of the International Organization of Standardization (ISO).

Figure 2: Cross-section of a rigid metal tray with no sign of detachment of the impression material from the walls. Follow the instructions for correct use of fixatives, and shun cheap plastic trays.

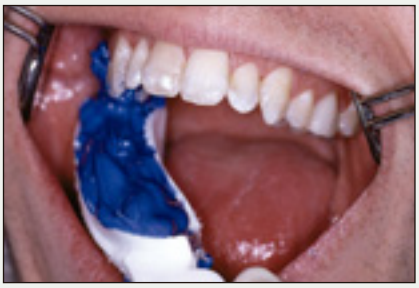

Figure 3: With the dual-arch impression technique, patient comfort is enhanced and it is simple for laboratory staff to pour the models. However, the critical issue with this technique is the possibility of erring in the vertical dimension.

Figure 4: In the dual-phase impressions, the clinician must ensure that the putty has not displaced the wash in the preparation area.

mixing pistols or automatic table mixers. Problems associated with reduced access and moisture control may remain, however.

The dual-arch impression technique is preferred by many because patient comfort is enhanced, the time required is shorter than for other methods, and it is simple for laboratory staff to pour the models (**Fig. 3**). Also, with practice, it is possible to make such impressions while having the patient bite in centric occlusion. The critical issue with this impression technique is the possibility of erring in the vertical dimension. Infrapositioned constructions cannot be corrected, whereas supracontacts (e.g., on gold alloys) can be adjusted. Any post-cementation adjustment on ceramic surfaces will lead to suboptimal glazing of the surface (regardless of the claims of the manufacturers of ceramic polishers). The clinician must therefore evaluate the circumstances when deciding if a dual-arch impression is adequate. Full-jaw impressions combined with a correct bite index will be more predictable. The choice between a monophase technique and a dual-phase technique is a matter of personal preference. A potential problem with the latter is poor compatibility between the putty and the wash (in terms of viscosity). It is important to verify in the final impression that the putty has not displaced the wash in the preparation area, as this is the least precise component (**Fig. 4**). Some proficient clinicians prefer to first take a putty impression and then to apply the wash in a second impression. This approach is rather sensitive to technique, and the operator needs to pay attention to surface contamination and correct re-placement of the hardened putty with the added wash while avoiding build-up of hydraulic pressure and escape of surplus wash material.

Routines and Solutions for Disinfection

Disinfection of the impression between the clinic and the laboratory should be mandatory to avoid cross-contamination. Metal impression trays must be meticulously cleaned and sterilized before reuse. Flexible plastic trays should not be reused.

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QUESTION 4

What are the merits of various types of post and core under fixed prostheses?

Background

The traditional method of cementing a cast post and core is still an excellent choice and can be done relatively easily through the indirect approach, but an adequate impression and a skilled technician to model the cast are required (**Fig. 1**). In addition, some clinicians adept in the direct intraoral technique are now using the new resin materials, which can be invested directly.

Alternatively, prefabricated posts are available in both metal and nonmetal materials. Some posts come with a preformed extracoronal part, while others rely on build-up with a "core material." About 30 core products are available, but there is little evidence that cores made from such materials should be preferred to other alternatives. Initially, most prefabricated metal posts were made from steel, which was later replaced by titanium. However, pure titanium is relatively brittle, and the producers have now changed to titanium alloys. The question of whether metal posts are so-called "active" or "inactive" remains controversial. The term "active" is ambiguous, but this characteristic is supposedly minimized by a design that has parallel or stepwise parallel walls rather than conical walls and a smooth or structured surface instead of threads. Some designs incorporate slots and grooves to "dissipate" active forces, and others feature a conical or ovoid post apex rather than a flat end. Most claims of effectiveness for post designs represent extrapolations from laboratory studies and computer simulations, and the validity of such measurements remains to be confirmed in long-term clinical trials.

There are about 20 brands of nonmetal posts, which can be grouped into 5 main categories. Ceramic posts, the first of which appeared around 1990, are either prefabricated or made in the dental laboratory. The first "black post," which was made from carbon fibres dispersed in resin, also appeared around 1990. Today, these black posts have been replaced by "white posts," which consist of inorganic fibres (quartz, zirconium or fibreglass) dispersed in a resin (**Fig. 2**). The so-called "translucent posts" are based on a polyester matrix and are meant to be combined with light-curing composite resin for permanent restoration or to be invested and cast.

The longevity of nonmetallic posts remains unknown but is usually thought to depend on the amount of dentin height remaining after preparation.[1] Given the lack of long-term clinical data, advertising for nonmetallic posts focuses on other virtues: colour (white is preferred); ease of removal (not usually a concern with prosthodontics); resistance to corrosion and cracking (which is in fact rare for metal posts); reinforcement of the root (an unnecessary feature that is virtually impossible to measure and compare); compressive, tensile, or transverse strength (also difficult to measure and compare).

In general, then, the question of whether nonmetallic posts are better or worse than metallic posts remains unanswered.[2,3]

Technique for Post Preparation

Teeth that have undergone root treatments are at risk for 2 major adverse effects, which must always be considered, regardless of the choice of post and core type: tooth fracture (because the amount of tissue has been reduced) and reinfection of the root canal via the mouth (which will compromise the tooth's survival and its use as an abutment).

Thus, always preserve as much of the tooth tissue as possible, and use a post and core restoration only when added vertical dimension is needed. Removing endodontic material and dentin to accommodate a post will actually weaken the tooth. Moreover, unless there is enough tooth substance

Figure 1: This traditional cemented cast remained unchanged under a 25-year-old bridge.

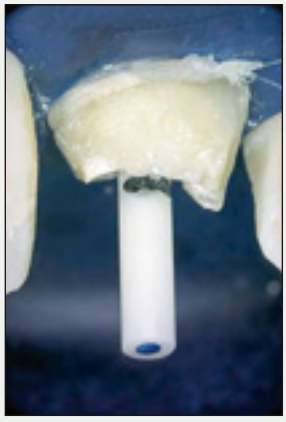

Figure 2: A "white post" consists of inorganic fibres dispersed in a resin.

to create a ferrule effect, it is questionable whether a crown should be made at all.

If a post is needed, use clinical judgement to balance the minimum length of post required for retention against the risk of reinfection. In the past, the minimal length of endodontic filling material has ranged from 3 to 6 mm (depending on the source of data, laboratory or epidemiological). In any case, strive for the best possible seal (to prevent leakage of both fluids and bacteria) by avoiding unnecessary removal of any root-filling material. When removing the root-filling material, be careful not to displace the remaining apical part; for example, twist drills can inadvertently displace the remaining gutta-percha.

Create a ferrule by placing the preparation margin at least 2 mm gingival to the core margin.

The post must be sufficiently strong to resist distortion. Class 3 gold alloy that has been correctly heat-treated presents a minimal risk of bending or fracturing.[4]

Rebuilding a tooth with a nonmetallic post combined with composite resin is a good option if the only alternative is to extract the tooth because of uncertain prognosis.

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Dr. Jokstad is the scientific affairs manager of the FDI World Dental Federation. He also serves as a JCDA editorial consultant. Dr. Jokstad is featured in "The JCDA Interview," found on page 219.

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