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. Readers are encouraged to do more reading on the topics covered. If you would like to contribute to this section, contact editor-in-chief Dr. John O'Keefe at jokeefe@cda-adc.ca.

QUESTION 1

What should I do if a maxillary third molar is inadvertently displaced into the adjacent soft tissues during surgical removal?

Displacement of a tooth into an adjacent tissue space is an infrequent complication of exodontia. A maxillary third molar may be displaced into the maxillary sinus during surgical removal, due in part to the thin surrounding bone. If a tooth is displaced into nearby soft tissues, it will typically migrate in a posterosuperior direction toward the infratemporal fossa. The extent of displacement depends on the direction and amount of force applied and local anatomical conditions.

Surgical technique can help to prevent this complication. A simple yet effective flap design for maxillary third molar surgery, the palatal diagonal flap (**Fig. 1**), has been described.[1] This flap provides excellent surgical access to the maxillary third molar region and permits placement of a suitable retractor, preventing displacement of a maxillary third molar during elevation. The Laster (Surgical Science, Toronto, Ont.) and the Minnesota (Hu-Friedy, Chicago, Ill.; **Fig. 2**) cheek retractors both provide good access to the tuberosity region, and the polished metal reflects light to improve visibility.

Sufficient removal of buccal bone is necessary before placing an elevator to deliver the maxillary third molar from its socket. With good retraction of soft tissues, the tooth can be observed carefully at all times during elevation. In the general practice setting, once it is established that the tooth has been displaced into the soft tissues, it is sometimes possible to manipulate the third molar toward the socket with finger pressure high in the buccal sulcus.[2] If this technique is unsuccessful, an aspirator tip can be introduced into the socket of the displaced tooth in a posterior direction. If both suggestions fail, the tooth should be left in situ and the patient referred to an oral surgeon. An explanation of what has happened should be provided.

A radiograph is required to establish the position of the tooth. A periapical radiograph is usually of limited value because of the extent of displacement of the tooth. A panoramic film is preferable, but it may not adequately demonstrate the spatial relation of the displaced tooth to adjacent anatomical structures (**Figs. 3a and 3b**). Computed tomography (CT) can be helpful to assess the exact location of the displaced tooth in the axial plane (**Fig. 4**). Three-dimensional CT reconstruction may also be desirable.

It is not always necessary to remove a displaced maxillary third molar, unless chronic infection, pain or a malocclusion develops or if trismus restricts jaw movement. However, the patient might request its removal in the absence of symptoms or a firm indication. Once the decision is made to retrieve the displaced maxillary third molar from the infratemporal fossa, general anesthesia is preferred because the surgical approach might have

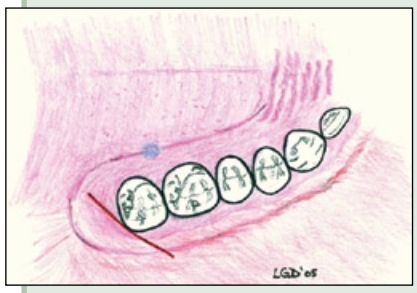

Figure 1: The palatal diagonal flap affords excellent unrestricted access to the maxillary tuberosity region. This drawing, courtesy of Dr. Lee Darichuk, demonstrates the approach to a right maxillary third molar.

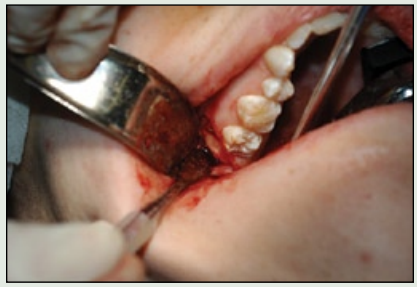

Figure 2: The tip of the Minnesota cheek retractor engages the posterior reflection of the palatal diagonal flap shown in **Fig. 1.** Photo courtesy of Dr. Lee Darichuk.

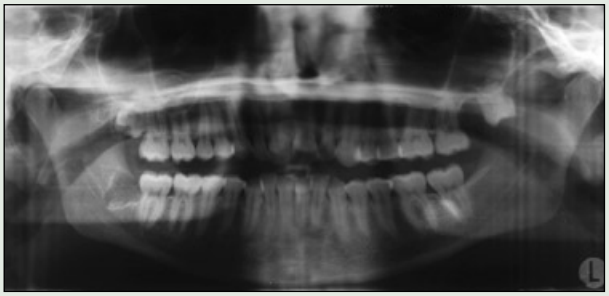

Figure 3a: A panoramic radiograph is a useful baseline tool to demonstrate the location of the displaced maxillary third molar, in this case tooth 28.

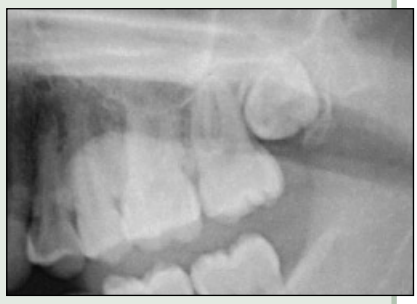

Figure 3b: A preoperative panoramic radiograph shows the original position of tooth 28.

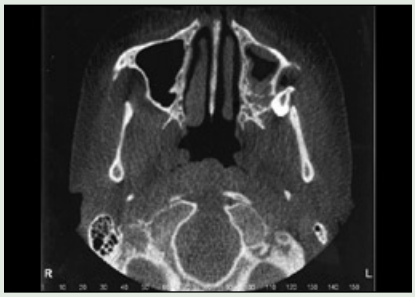

Figure 4: Axial computed tomography image shows the position of the displaced tooth 28 seen in **Fig. 3** (imaging courtesy of Dr. Elaine Orpe).

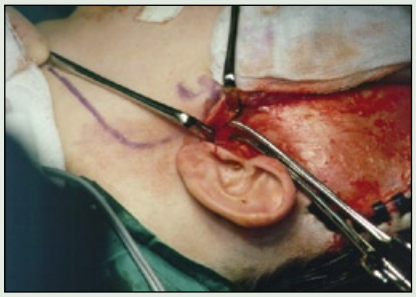

Figure 5: A hemicoronal flap permits surgical access to the infratemporal fossa and a displaced maxillary third molar tooth from the superior aspect.

to be modified intraoperatively. Local anesthetic solution with vasoconstrictor is administered into the soft tissues to reduce bleeding.

An intraoral approach is typically made in the posterior sulcus and a mucoperiosteal flap is raised with a periosteal elevator, which might reveal the tooth. If the tooth cannot be located, image-intensifying cineradiography[3] might be of value. A Gillies approach can be made via an incision in the hairline; the displaced tooth is palpated and pushed inferiorly using a Howarth periosteal elevator introduced deep into the temporalis fascia.[3] Using an 18-gauge spinal needle with stiletto in situ instead of a Howarth elevator to push the tooth inferiorly avoids the need for an incision in the temporal region.[4]

If the displaced tooth still cannot be retrieved or if it is high in the infratemporal fossa, a transantral approach is possible with careful dissection of the posterior wall of the maxillary sinus.[5] Alternatively, a hemicoronal incision permits access via elevation of skin from the temporalis fascia (**Fig. 5**). Dissection then proceeds through fascia and muscle to the lateral wall of the orbit.[6] At this point, one expects the tooth to be seen or palpated and retrieved. Once a displaced maxillary third molar has been retrieved, the soft issues are debrided and closed in layers with sutures. Antibiotics are indicated to prevent infection in the infratemporal space.

Given the inconvenience to the patient, the time and potential costs involved in retrieval of a displaced tooth and the likelihood of litigation, it is preferable to avoid iatrogenic displacement of a maxillary third molar by careful surgical technique.

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The author has no declared financial interests in any company manufacturing the types of products mentioned in this article.

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QUESTION 2

What are the main factors I should consider when choosing between different bonding systems?

The Principles of Bonding

Adhesion can be defined as the molecular interactions responsible for holding together 2 substrata. Molecular interactions are most commonly achieved with adhesives, liquids with some degree of viscosity that are intended to intimately wet the 2 substrata and provide the required molecular contact. In addition, some adhesives have the ability to form chemical bonds with the substrata, thus enhancing adhesion.

In general, there are 3 steps in an adhesive procedure: preconditioning, priming and placement of the adhesive. Preconditioning is intended to clean the substratum and, if possible, maximize its surface area; the primer is intended to change, if necessary, the chemistry of the substratum to render it compatible with that of the intended adhesive; and the adhesive (via the primer, if required) provides molecular contact between the 2 substrata to achieve adhesion.

In dentistry, the substrata involved are hard tooth tissues and restorative materials. This article focuses on dental bonding systems aimed at providing adhesion between hard tooth tissues and resin composite materials. The matrix of dental resin composites is based on dimethacrylates, and the same type of compounds are therefore used in dental adhesives.

Preconditioning of hard tooth tissues is currently achieved by acid etching, the application of acidic liquids onto the hydroxyapatite-containing hard tooth tissues. Because the acidic liquid is applied simultaneously onto enamel and dentin, the procedure has been called "total-etch." The acidic liquid cleans the surface, removes the smear layer, dissolves enamel and demineralizes dentin.

Dissolution of the core and the periphery of enamel prisms is differential, which leads to a significant increase in surface area; on dentin, the circumferential enlargement of the dentinal tubules, resulting from demineralization of the peritubular dentin, and the demineralization of intertubular and intratubular dentin leads to an increase in surface area. Dental adhesives, which have low surface energies, can effectively wet preconditioned high-surface-energy enamel, so there is no need for primers on enamel.

In contrast, the moist, low-surface-energy dentin is incompatible with hydrophobic dental adhesives, and application of a primer is required. The most commonly used primer in dental adhesive bonding systems is hydroxyethylmethacrylate (HEMA), a molecule that has a hydrophilic end and a hydrophobic end. This small molecule adsorbs onto dentin via the hydrophilic moiety and, through its methacrylic moiety, renders the

Table 1 Dental adhesive systems

System	Steps (estimated time in seconds)	Total time (estimate)
Total-etch multistep system (or "total-etch multi-bottle" or "etch-and-rinse multi-bottle" or "smear removal multi-bottle")	Etch (20), rinse (10), dry (5) Apply primer (5), dry (5) Apply adhesive (5), dry (5) Cure (10)	65 seconds
Total-etch 2-step system (or "total-etch, 1 bottle" or "etch-and-rinse 1 bottle" or "smear removal, 1 bottle")	Etch (20), rinse (10), dry (5)[a] Apply primer and adhesive (5), dry (5) Cure (10)	55 seconds
Self-etching 2-step system (or "smear dissolving, 1 bottle")	Apply self-etching primer (20), dry (5) Apply adhesive (5), dry (5) Cure (10)	45 seconds
Self-etching 1-step system (or "smear dissolving, all-in-1")	Apply (20), dry (5) Cure (10)	35 seconds

[a]*Some of these systems require moist bonding, which makes them more sensitive to technique as the required degree of moistness is undefined.*

dentin hydrophobic and compatible with dimethacrylate adhesives.

In summary, then, a typical dentin bonding system contains 3 components: a preconditioner (the acidic liquid), a primer (HEMA or a similar molecule) and the adhesive (a dimethacrylate).

Considerations for Currently Available Systems

The currently available dental adhesive systems can be classified according to how these 3 components are provided and applied (**Table 1**):

1. Total-etch multistep systems: Systems in which the etchant, primer and adhesive are delivered in separate containers and are to be applied in sequence. These systems are considered the "gold standard," and their performance both in vitro and in vivo is superior to that of all other systems. The application of these systems requires the most time but is considered the least sensitive to technique.
2. Total-etch 2-step systems: Systems in which the primer and adhesives have been combined into a single component. In some systems, the primer–adhesive combination cannot tolerate the presence of water. For these systems, the so-called "moist bonding" technique must be used to ensure that the mixture can penetrate the preconditioned, demineralized dentin. The requirement for moist-bonding renders these systems sensitive to technique.
3. Self-etching 2-step systems: Systems in which the preconditioning and priming is achieved by the use of a self-etching primer (SEP). For these systems, there is no rinsing after application of the SEP, which simplifies and shortens the procedure. The performance of these systems both in vitro and in vivo approaches that of the total-etch multibottle systems. The 2 major concerns associated with these systems are inadequate etching of enamel and the possibility of continuous etching of the substratum by the SEP. These concerns raise questions about the long-term performance of these systems.
4. Self-etching 1-step systems: Systems in which all components are premixed and applied in a single step without subsequent rinsing. These systems have a strong appeal since they significantly shorten and simplify the procedure. However, in vitro and in vivo studies have shown great variability in results. The 2 major concerns associated with these systems, inadequate etching of enamel and the possibility of continuous etching of the substratum, raise questions about their long-term performance.

Conclusions

This brief article should help practitioners in both their understanding of the dental bonding systems on the market and their selection of a suitable system for their particular practice. The sources in the suggested reading list below offer more in-depth help in assessing dental bonding systems.

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Further Reading

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Interested in reading more on bonding systems? CDA members can order these articles online by visiting the CDA Resource Centre at www.cda-adc.ca/resource_centre.

QUESTION 3

What is the current status of dental ceramics?

Basic Principles Revisited

In general, ceramics are defined as inorganic, nonmetallic crystalline materials, which consist of metallic and nonmetallic elements bonded together primarily by ionic and/or covalent bonds. Glasses share the same definition, but they are amorphous rather than crystalline. Traditional ceramics are based on silicate (SiO_4^{4-}) and contain different percentages of silica (SiO_2), feldspars ($MO{\cdot}Al_2O_3{\cdot}nSiO_2$) and clay ($Al_2O_3{\cdot}2SiO_2{\cdot}2H_2O$).

In traditional dental ceramics, the so-called feldspathic ceramics, the feldspar forms the glass matrix into which silica is distributed, and the clay content is less than 5% or none. Feldspathic ceramics are esthetically adequate to replace tooth enamel but have low flexural strengths (about 100 MPa) and a low resistance to the propagation of cracks, i.e., a low fracture toughness (K_{IC}) of about 1 MPa·m$^{1/2}$.

To improve (if only slightly) both the fracture resistance and the flexural strength of feldspathic ceramics, leucite crystals (as in IPS Empress ceramic; Ivoclar Vivadent, Schaan, Liechtenstein) or mica plates (as in Dicor, Dentsply/Caulk, Milford, Del.) can be induced to precipitate. Feldspathic ceramics have been used in conjunction with metal copings in metalloceramic restorations, which have a long and successful record of in vivo success and are considered the "gold standard."

Because of a greater emphasis on esthetics and concerns about the release of metal ions, there has been pressure to develop all-ceramic restorations. In these restorations, the metal coping is replaced with industrial-type ceramic copings. For this purpose, alumina (Al_2O_3) (as in Optec OPC, Jeneric Pentron, Wallingford, Conn.; Procera, NobelBiocare, Gothenburg, Sweden; In-Ceram Alumina, Vita, Bad Säckingen, Germany), spinell (as in In-Ceram Spinell, Vita) or partially stabilized zirconia (as in In-Ceram Zirconia, Vita) have been used. These all-ceramic copings have flexural strength in the range of 600 to 1000 MPa and fracture toughness of 5 to 10 MPa·m$^{1/2}$. It should be emphasized that the fracture toughness of dental alloys (> 40 MPa·m$^{1/2}$) is significantly greater than that of any ceramic and that feldspathic porcelains are used in conjunction with *all* of the above-mentioned all-ceramic copings to render the restoration esthetically acceptable. The outer feldspathic ceramic layer is applied and fired, whereas ceramic copings can be achieved by sintering, casting, pressing, slip-casting or machining (i.e., computer-aided design and manufacture).

New Developments and Their Clinical Significance

Significant changes in the field of all-ceramic restorations can be anticipated in the processing of existing materials and in the design of restorations, rather than in the materials themselves. Changes in processing will focus on minimizing the size and presence of flaws and on optimizing existing structural modifications (or introducing new ones) aimed at improving the fracture resistance and fatigue performance of ceramics. Changes in design will attempt to incorporate patient-specific parameters, along with well-defined structural requirements to minimize and optimize stress fields in sensitive areas. Efforts in this area have already resulted in the wide acceptance of porcelain veneers and single all-ceramic crowns, in the short-term (5 years) success of 3-unit fixed partial bridges, and in promising results for longer (5-unit) fixed partial bridges based on ceramics with high strength and fracture toughness. Recent developments have also led to a significant decrease in the recommended tooth reduction for all-ceramic crowns (1.5 mm), which now matches that required for metalloceramic restorations.

In closing, I would like to cite from a recent review by McLean: "In the 21st century, the challenge of producing high-strength ceramics without sacrificing translucency may be solved, but the metal-ceramic restoration is likely to be with us for a long time."

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