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. This month's responses were provided by Dr. Mahmoud R. Ektefaie (Questions 1 to 3) and Dr. Leendert Boksman (Question 4). If you would like to submit or answer a question, contact editor-in-chief Dr. John O'Keefe at jokeefe@cda-adc.ca.

Question 1

What is the role of sodium hypochlorite (NaOCl) as an irrigant in root canal therapy? What is the safest concentration of NaOCl to use during irrigation?

Because of the complexity of the root canal system, irrigants are used to supplement mechanical preparation of canals. An ideal irrigation solution should be capable of penetrating and disinfecting the entire root canal system by dissolving both organic components (necrotic and non-necrotic pulpal tissue, predentin and microorganisms) and inorganic components (mineral content of the dentinal tubules) of the smear layer. In addition, an ideal irrigant should mechanically flush any loose debris, lubricate canals during biomechanical preparation and have low tissue toxicity.[1]

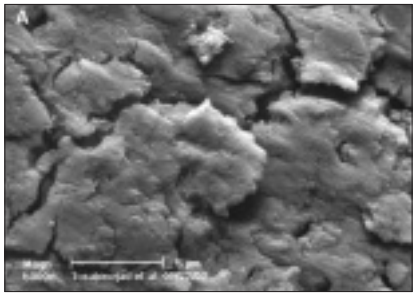

Figure 1a: *Smear layer on the surface of a root canal irrigated with distilled water.*

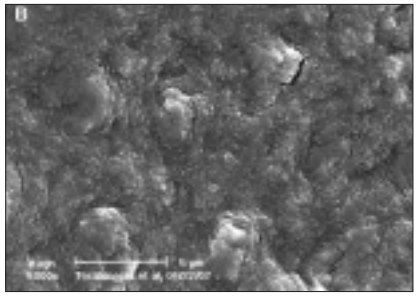

Figure 1b: *Smear layer on the surface of a root canal irrigated with 5.25% sodium hypochlorite.*

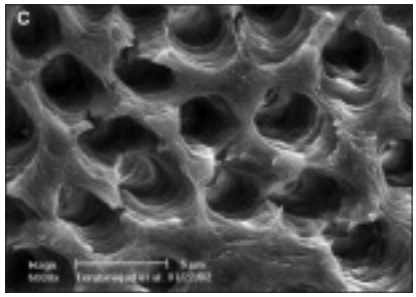

Figure 1c: *Smear layer on the surface of a root canal irrigated with 5.25% sodium hypochlorite and a final rinse of 17% EDTA.*

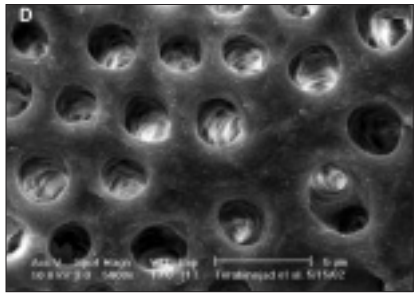

Figure 1d: *Smear layer on the surface of a root canal irrigated with 1.3% sodium hypochlorite and a final rinse of MTAD.*

No single irrigant fulfills all of these criteria, and sodium hypochlorite (NaOCl) remains the most widely used irrigation solution in endodontics. NaOCl has very effective disinfecting and tissue-dissolving properties but is incapable of removing the smear layer by itself and is cytotoxic to periradicular and vital tissues.[2] Through a biochemical process, free chlorine (as the hypochlorite ion, OCl^-) in solution breaks down the necrotic pulpal tissue and debris; it also disturbs the metabolic processes of bacteria by irreversibly oxidizing their enzymes.[3] NaOCl is very effective for flushing and displacing the loose debris inside canals, but the apical extent of its effectiveness is a function of the depth of needle insertion.[4] As noted above, NaOCl is ineffective in removing the smear layer, but NaOCl combined with 17% ethylenediaminetetra-acetic acid (EDTA) has good capability for removing the smear layer. More recently, a new irrigation solution, MTAD (a mixture of a tetracycline isomer, an acid and a detergent) used in conjunction with NaOCl has offered exceptional capability for smear layer removal with no significant structural change of the dentinal tubules[5] (**Fig. 1**).

The concentration of NaOCl that is safe and suitable is still a matter of debate. The endodontic use of commercially available 5.25% NaOCl (full-strength bleach) has raised some concerns. Although rare, severe complications have been reported after accidental injection of 5.25% NaOCl beyond the root apex.[6] Although 5.25% NaOCl is an effective tissue solvent, it is highly cytotoxic to vital tissues, and there is no significant difference in the tissue-dissolving and antibacterial capabilities of 1%, 2.5% and 5.25% NaOCl.[7] The complete removal of pulpal remnants and predentin from uninstrumented surfaces has been demonstrated even at a concentration of 1%.[7]

To reduce the adverse effects of NaOCl, clinicians may prefer to use lower concentrations, but they must keep in mind that the dissolution power of NaOCl at such lower concentrations is significantly reduced. Nonetheless, a 1% solution retains adequate disinfecting and tissue-dissolving capabilities, provided the lower dissolution power is

compensated by using a larger volume and higher frequency of irrigation and by heating the NaOCl solution during intracanal irrigation. With crown-down shaping of the coronal and middle thirds of the canal and use of a smaller irrigation needle, deeper penetration of the irrigant (closer to the working length) can be achieved to facilitate the flow of irrigant and debris removal. ➧

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Question 2

What are the signs and symptoms of inadvertent injection of sodium hypochlorite (NaOCl) into the periapical tissue? How can I prevent this from happening?

Improper use of sodium hypochlorite (NaOCl) during endodontic treatment may result in undesirable outcomes ranging from discoloration of the patient's clothing and a bad taste in his or her mouth to more severe symptoms and complications. The tissue-dissolving capability and the toxic effects of NaOCl on vital tissues have been known for some time.[1]

Ideally, irrigants should be confined to the root canal system while performing root canal therapy; however, this is not always possible. Extrusion of NaOCl beyond the apical foramen may happen during overinstrumentation or, in teeth with open apices, through external resorption or unnoticed perforation. Binding of the irrigation needle tip inside a canal and use of too much pressure during irrigation can also result in extrusion of irrigant into the periradicular tissue, leading to tissue destruction and necrosis. The adverse affects of NaOCl reaction with periradicular tissues have also been described.[2–4] The immediate symptoms of inadvertent injection of NaOCl into the periradicular region common among all reported cases include the following:[2]

- sudden severe pain and burning sensation
- progressive swelling and severe edema
- profuse bleeding from the root canal
- immediate hematoma and ecchymosis of the skin.

Symptoms such as trismus, secondary infection, reversible anesthesia, paresthesia or even hyperesthesia might follow the initial severe inflammatory reaction. Although in most cases these symptoms are reversible with

Figure 1a: *A periapical film reveals a reduced pulp chamber, an almost untraceable root canal system and superimposition of the inferior border of the maxillary sinus over the root apices of tooth 16.*

Figure 1b: *The post-treatment periapical film demonstrates the complexity of the root canal treatment.*

Figure 2a: *An off-angle view of tooth 35 reveals a near-perforation, which occurred during an attempt to locate the root canal during access preparation (the left border of the access preparation is marked with arrows).*

Figure 2b: *A more straight-on view can give the operator a false impression of where the access preparation is located.*

Figure 3: *The ProRinse endodontic irrigating probe (Dentsply, Tulsa Dental, Johnson City, Tenn.) is among the smallest-bore irrigating needles, with features of flexibility, side-venting and a closed blunt end.*

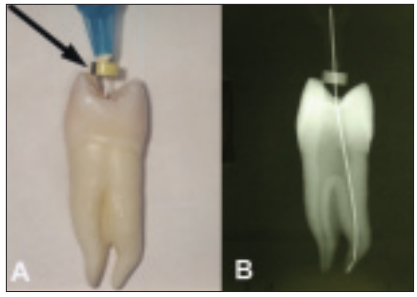

Figure 4: *(A) Rubber stoppers (arrow) can be used to measure the depth of insertion and the orientation of the tip of the needle during irrigation. (B) A ProRinse probe is inserted passively to the level of the apical seat after the canal is instrumented up to size 40.*

proper treatment, the experience can be traumatic and frightening for the patient. General practitioners should therefore take extra precautions to avoid such situations.

The best treatment is always prevention. To prevent the adverse effects of NaOCl, consider the following steps:

- *Thoroughly examine the tooth to be treated.* A complete clinical and radiographic assessment of the tooth may reveal that the root canal system is complex enough to warrant referral to an endodontist for proper management (**Fig. 1**).
- *Always use isolation.* A rubber dam is the most effective barrier to protect the intraoral tissue from the damaging effects of NaOCl.
- *Use an apex locator to confirm the working length.* After radiography, this is the most accurate and reliable method of determining the actual working length.
- *When in doubt, obtain a radiograph.* If you are encountering difficulty in locating the canals during canal preparation, stop and obtain another film. Be confident about the area you are working in (**Fig. 2**).
- *Use proper needle type and size.* A smaller-bore, side-venting irrigating needle of a size appropriate for the prepared canal is recommended[5] (**Fig. 3**).
- *Use a plastic stopper on irrigating needles.* A stopper can guarantee the position of the needle tip inside the canal system, where tactile sensation is limited (**Fig. 4**).
- *Use an appropriate method to deliver the irrigation solution.* Use low, constant pressure, withdrawing the needle slightly from the binding point.
- *Use a dilute solution of NaOCl.* At a concentration of 1%, NaOCl retains adequate antibacterial and tissue-dissolving capabilities.[6] ◆

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Question 3 What are the treatment options for a sodium hypochlorite (NaOCl) incident?

Even when practitioners take extra precautions, irrigation accidents may occur, and the resulting complications could be devastating to the patient. The treatment of a sodium hypochlorite (NaOCl) accident is mostly palliative but should be initiated as soon as the first signs of the problem appear. Although there is no standard procedure for managing such an incident, the protocol suggested by Hales and colleagues[1] summarizes the typical approach:

- Provide immediate pain relief by administering local anesthesia to the affected area.
- Allow the drainage of the inflammatory exudate and dilute the NaOCl by irrigating the canal system with normal saline solution.
- Reassure the patient and inform him or her of the cause and severity of the complications.
- Reduce swelling by applying cold compresses in 15-minute intervals for the first 24 hours, followed by warm compresses thereafter.
- Prescribe acetaminophen-based narcotic analgesics to control pain, prophylactic antibiotics to prevent

secondary infection, and steroid medication to control inflammatory reaction.
- Set up regular recall appointments to monitor the patient's recovery and complete the endodontic therapy upon resolution of the acute symptoms.

Although these steps are useful in the management of NaOCl accidents, in rare instances healing is incomplete and the symptoms do not resolve completely. In one reported case, hyperesthesia and extreme cold sensitivity were present 4 years after the accident.[2] This might have been the result of irreversible and unpredictable nerve damage caused by the tissue-dissolving action of NaOCl. It might be possible to avoid this problem by attempting to eliminate NaOCl from the infiltrated tissue through a combination of dilution with saline and bone curettage immediately after occurrence of the incident. This might reduce the severe inflammatory reaction without further unpredictable nerve damage. The dilution method without bone curettage that is suggested by Hales and colleagues[1] might not be effective in this situation, since irrigating the root canal system with 0.9% NaCl has no effect on the NaOCl outside the tooth confinement. ➧

References

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Dr. Mahmoud R. Ektefaie *is a general dentist in private practice, North Vancouver, B.C. He is also a preclinical instructor at the faculty of dentistry, University of British Columbia, Vancouver, B.C. E-mail: ektefaie@shaw.ca.*

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Question 4

How do I minimize the amount of occlusal adjustment necessary for a crown?

Clinical Problem

Local laboratories report that they receive a wide variety of impression trays, impression materials and bite registrations, all of which affect the final fit of a crown. In this article, the focus will be on bite registration and how it may affect the time spent altering the occlusal anatomy of crowns and bridgework to match the patient's occlusion.

Management of the Problem

When taking any bite registration it is imperative to match the accuracies of the materials you use, including those used for the final impression, the bite registration and the opposing model. Most bite registrations are inaccurate, and some of the problems are created by "bounce" in the material used, which may include wax, putty, silicone or polyvinyl siloxane. Most of us have been taught to take a final impression with a highly accurate impression material. Polyvinyl siloxane is the current choice of most clinicians. The polyvinyl siloxane allows for a second pour, which can be used to create an untouched die, so you can check the fit of the crown before delivery to the patient. Usually an alginate impression is taken of the opposing arch and is poured-up in the office in die stone. This is where a discrepancy can arise. A full-arch bite registration taken in a very accurate material such as polyvinyl siloxane is more accurate than the alginate stone model (**Figs. 1** and **2**). When we articulate the models (shown in **Fig. 3** as 2 opposing alginate-produced master casts), the bite created by the models is obviously open, and the bite registration does not fit. Because the anterior teeth have little incisal anatomy, when the models are mounted, the inaccuracy in the bite registration allows them to shift, which creates a false bite relationship.

Perry[1] has written an excellent article on using polyvinyl siloxane impressions and stock trays for study models. He notes that polyvinyl impression material may be slightly more expensive than alginate, but points out that the benefits far outweigh the cost in terms of lost chair time.

There are 2 other ways around this problem. One method is to have the patient close the jaw in centric occlusion and obtain a lateral bite registration with polyvinyl siloxane. With the patient's jaws lightly closed, pull back the lips and cheek, inject the bite registration material into the site of the preparation, creating a small donut (**Figs. 4** and **5**). This small registration fits in the space between the prepared tooth and the opposing tooth or teeth, without affecting the interdigitation of the arches. Using a bite registration material of high durometer polyvinyl siloxane that is not brittle and that has no compression or bounce during articulation is critical.

Another method that works well for a single restoration in a patient with definitive cuspid rise is the dual-arch impression technique. A rigid metal tray must be used to prevent flexion and distortion. The impression material

Figure 1: *Occlusal photograph of alginate-produced stone model.*

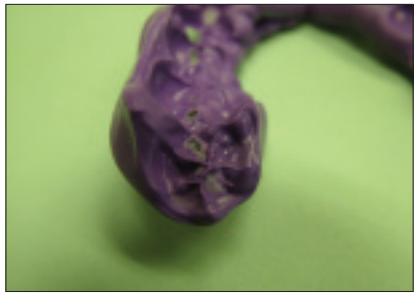

Figure 2: *Occlusal photograph of polyvinyl siloxane (detail).*

Figure 3: *Two alginate-produced stone models that are not seating on the bite registration.*

Figure 4: *Injection of bite registration material with the closed-bite technique.*

Figure 5: *Bite registration in place.*

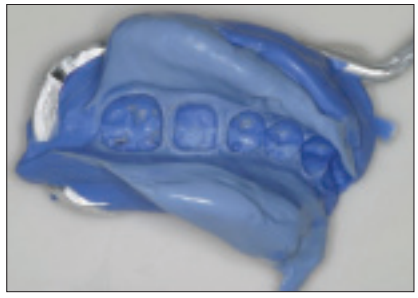

Figure 6: *Rigid metal quadrant impression tray with matched inflexible tray support material.*

used with this technique must be a specific inflexible polyvinyl siloxane, since it acts as part of the tray to contain the light body material, which is syringed around the final preparation (**Fig. 6**). With this method, the final impression of the preparation, the bite registration and the opposing model are all obtained at once, which minimizes the discrepancy between impression and bite registration.

It must be remembered that in all clinical impression-taking, the patient must bite passively; an aggressive clench can intrude the teeth 5–7 µ which can affect the fit. The same holds true when taking a full-arch impression. The full arch must be allowed to set passively with no seating pressure to minimize the chances of flex in the tray and the material being forced to set under compression and possible flexion.

These clinical hints should help to minimize chair time in seating laboratory restorations. ◆

Dr. Leendert Boksman *is in private practice in London, Ontario. He is director of clinical affairs for Clinical Research Dental. E-mail: lboksman@clinicianschoice.com.*

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