

Exploring hand-held dental X-ray devices and their impact on digital dentistry: rationale and best practices

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ABSTRACT

Introduction: Dental radiographs are essential in oral health care, facilitating accurate diagnosis and treatment planning. In various situations, such as in rural communities, seniors' homes, military settings or in patients with limited mobility, traditional wall-mounted X-ray machines may not be suitable. Hand-held dental X-ray devices have emerged as a valuable solution for these special circumstances.

However, because Canadian regulatory bodies have only recently approved these portable devices, information on their proper use is limited.

Description: This short communication consolidates relevant information on regulations, safety, and best practices to assist Canadian oral health care providers in adopting this technology effectively and safely. Additionally, it shares insights gained from using hand-held X-ray devices in a dental initiative that delivers care to underserved Canadians through mobile clinics.

RÉSUMÉ

Introduction : Les radiographies dentaires sont essentielles pour les soins de santé buccodentaire, en facilitant des diagnostics précis et la planification des traitements. Dans diverses situations, par exemple dans les collectivités rurales, les maisons des aînés, les installations militaires ou les patients à mobilité réduite, les appareils de radiographie muraux traditionnels peuvent ne pas convenir. Les appareils à rayons X portatifs se sont révélés être une solution précieuse pour ces circonstances particulières. Toutefois, comme les organismes de réglementation canadiens ont seulement approuvé récemment ces appareils portatifs, l'information sur leur utilisation appropriée est limitée. **Description :** Cette courte communication regroupe des renseignements pertinents sur la réglementation, la sécurité et les pratiques exemplaires afin d'aider les fournisseurs canadiens de soins buccodentaires à adopter cette technologie de façon efficace et sécuritaire. De plus, elle partage les connaissances acquises grâce à l'utilisation d'appareils de radiographie portatifs dans le cadre d'une initiative qui offre des soins buccodentaires à une population canadienne mal desservie par l'entremise de cliniques mobiles.

Keywords: dental equipment; dental radiography; diagnosis; portable X-ray; X-rays

CDHA Research Agenda category: access to dental hygiene care and unmet needs

PRACTICAL IMPLICATIONS OF THIS RESEARCH

- Portable X-ray devices offer oral health care practitioners a safe and efficient imaging solution, particularly for patients in remote areas, those with mobility limitations, or during a national crisis, ensuring consistent access to oral health care.
- These portable and reliable devices are an effective alternative to wall-mounted X-ray systems, enabling the oral health care team to maintain a high standard of care, even in challenging circumstances.

INTRODUCTION

Radiographic imaging is fundamental to an oral health professional's daily clinical practice.¹ It is essential to providing quality diagnosis and to supporting treatment planning and shared decision making.² As modern dentistry evolves, novel technologies emerge, improving the ability of oral health care providers to deliver optimal care and expanding access to oral health care. Portable X-ray devices are just one example of a new technology that is being used with increasing frequency in dentistry.^{1,3,4}

Hand-held devices were first introduced to optimize dental radiographs in special circumstances⁵ such as military settings^{3,4,6,7} and in times of disasters.^{7,8} More recently, this technology has been used in the care of the aging population, where mobility may be limited,^{1,2,4,8,9}

in remote areas, with people under house arrest,⁷ in forensic dentistry,^{3,8,10,11} and with patients under general anesthesia¹. The use of portable dental X-ray devices increases efficiency due to their transportability. They also reduce costs by decreasing the need for a wall-mounted X-ray device in every clinical operatory.^{8,11}

Portable dental X-ray devices are available in various designs. One example is the NOMAD device (DEXIS, United States), recently approved in Canada,¹² as presented in Figure 1. Approved devices must have internal and external shielding to reduce radiation exposure and to protect the operator, allowing the operator to remain in the room with the patient. Essential accessories include a rectangular collimator for a restricted exposure area and

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a remote exposure handset to be used with an adjustable stand (Figure 2).¹³ The operator holds the device during the exposure with the backscatter shield parallel to the floor and the unit as close to the patient as possible. The patient's head should be adjusted to retain the X-ray beam in the horizontal plane (Figure 2).^{14,15}

The standard regulation for portable X-ray devices in Canada was released in 2022.⁵ Safety Code 30, released by Health Canada, offers a limited set of guidelines for the use of these devices.⁵ Canada is known to have many remote areas and rural communities in need of professional oral health care services, where dental clinics are often limited or nonexistent. The Canadian population is also aging; a growing number of older adults are bedridden or immobile, prompting a need to find new ways and tools to optimize oral health care delivery.¹⁶ Access to and knowledge about portable X-ray devices could improve oral diagnosis and the quality of care provided to these communities.

Around the world, the use of hand-held X-ray devices continues to increase, and while studies, guidelines, and discussions are already taking place in different countries,⁴ Canada has not fully embraced this technology yet. Therefore, this short communication aims to guide Canadian oral health care providers on best practices for the use of portable X-ray devices and raise awareness about this technology as a valuable resource for enhancing access to oral health care.

CASE DESCRIPTION

At the Mike Petryk School of Dentistry, University of Alberta, the NOMAD Pro 2 portable dental X-ray device has been implemented as part of the Access For All (A4A) Initiative (ualberta.ca/en/impact/access-for-all-dental-care-to-metis-communities.html). This student-led, student-funded program works alongside the Métis Nation of Alberta to address the oral health needs of communities across Alberta that may otherwise lack access to professional oral care services. Under the supervision of instructors, dental and dental hygiene students travel to remote communities and set up mobile clinics where they provide free, essential oral care and gain vital hands-on experience working with underserved populations.

Given the lack of dental facilities with wall-mounted dental X-ray equipment in these regions, portable X-ray devices have become essential to the A4A dentistry initiative as they assist in formulating diagnoses and maintaining the standard of care. As the student lead noted, "The portable dental X-ray device is integral to the trip. The treatment provided in that remote area cannot happen without this device." Students and instructors participating in the program receive a 1-hour training session conducted by the oral radiology team. This training focuses on properly using the device, retaking documentation, and radiation protection measures to ensure safety while providing care to the communities.

Figure 1. Portable X-ray device mounted with a stand



Figure 2. Operator holding the portable device



DISCUSSION

Are the devices safe for the operator?

Ionizing radiation exposure levels using portable X-ray devices remain below the limits set by regulatory bodies.^{1,2,17} While wall-mounted X-ray devices in dentistry typically provide variable exposure levels and adjustable voltage options,²⁻⁴ hand-held devices generally have fixed voltage and current settings, with only adjustable exposure times³. To achieve comparable image quality to wall-mounted devices, exposure times on hand-held devices often need to be increased. This longer exposure duration may increase the risk of motion-related errors.⁴

The position of the portable X-ray device relative to the position of the operator can impact radiation exposure, reinforcing the need for proper training and adherence to best practices.¹ Research has shown that with proper positioning, the measured dose with NOMAD for both patient and operator is well below recommended levels.¹⁴ According to the NOMAD specifications, the average annual dose absorbed by the operator is up to 0.65 mSv and 0.13 mSv with film and digital sensor, respectively. In addition, tests conducted with NOMAD in 715 digital and/or film radiographs demonstrated an average whole body operator dose of 0.04 mSv.¹⁸ Maximum protection from backscatter radiation exists when the unit is positioned near the patient, is perpendicular to the operator, and the backscatter shield is fully extended towards the patient.¹

Are the devices safe for the patient?

Portable X-ray devices can be considered safe for patients when used responsibly and according to established standards. The low exposure settings, digital sensors, and shielding incorporated into the devices, combined with proper operator training and adherence to safety guidelines, minimize radiation risk to patients.⁵ As with any X-ray procedure, the benefits of the diagnostic information gained should always outweigh the small potential risks associated with radiation exposure.⁴

Health Canada: Radiation Safety Code 30 guidance⁵

- Hand-held X-ray devices should be supported by a stand and operated remotely with an irradiation switch. Manual handling should only occur if a stand cannot achieve a diagnostically acceptable image.
- When a portable X-ray device is used, all persons, excluding the operator and patient, should be at least 2 metres away from the device.
- Each operator using the device should wear a dosimeter for at least the first year of use.
- The device should be stored in a locked area when it is not in use to prevent any damage or unauthorized use.

A critical point is ensuring that the portable equipment used is registered and cleared by Health Canada. The online availability of affordable but unregulated alternatives poses a significant risk. These unregistered devices may not meet established safety standards, potentially exposing both operators and patients to unnecessary radiation. Health care providers must recognize and avoid noncompliant devices; while cost may be a factor, compromising on safety by using unregulated equipment is unacceptable.

Oral health care equity and future directions

Underserved rural and remote populations,¹⁹ as well as the aging population,¹⁶ are growing concerns that need to be addressed. Improving access to oral health care and reducing inequities in Canada are the main goals of the recently released *National Oral Health Research Strategy*, which is aligned with Health Canada priorities.²⁰ In this context, portable X-ray devices should be explored as a valuable tool to help Canadian oral health care providers better serve those demographics.

Future studies should examine the challenges in using and implementing portable dental X-ray devices in Canada, including issues related to image quality, and identify the types of errors that may arise from using these devices and the educational support needed to mitigate them.

Clinical relevance

In this era of modern dentistry, oral health professionals should be innovative and seek ways to increase efficiency by delivering optimal care, providing everyone with access to oral health care and serving patients with the best of standards. The portable X-ray device has emerged as a safe alternative.⁵ Whether patients live in remote areas, have disabilities or restrictions that prevent them from accessing a dental clinic, or whether a nationwide crisis has occurred, this device is invaluable to oral health care professionals.^{1-3,7,9-11}

The benefits of these devices as a tool to help provide oral health care to specific communities should also be explored. With proper training and use, portable dental X-rays can be a valuable resource for mobile clinics, oral health programs in community health centres, shelters, long-term care facilities, and alternative delivery models, helping to improve access to oral health care.

Recommendations based on the literature and recent Canadian regulation

1. *Training:* Operating personnel in the dental clinic should receive training from the manufacturer or reseller of the portable X-ray device to establish protocols that minimize radiation exposure risks.^{1,2,8}
2. *Use of lead aprons:* Patients should wear a lead apron to reduce radiation exposure from the X-ray beam, according to their province's regulations.³
3. *Dosimeter use:* Wearing personal dosimeters to monitor radiation exposure is highly recommended. In some Canadian provinces, dosimeter use is mandatory.²¹
4. *Use of digital sensors:* Digital sensors are preferred over film, as they reduce exposure time and align with the ALARA (As Low As Reasonably Achievable) principle.⁷
5. *Body position and shielding:* The operator's body should stay parallel to the device and behind the scatter shield.² For maxillary anterior radiographs, the patient should tip their head downwards; for maxillary posterior radiographs, the patient is required to tip their head sideways to be able to capture the radiograph horizontally; for mandibular anterior radiographs, they should tip their head upwards.¹⁵ The operator should remain within the device's protective zone.¹ To optimize shielding, the object should be kept close to the device's tube opening, as distance affects the backscatter angle.^{8,10}

CONCLUSION

Portable X-ray devices offer a potential solution for providing care in settings where traditional wall-mounted equipment is not feasible. This short communication suggests that these hand-held devices can be used safely with proper training and a well-developed quality assurance program to protect oral health care providers and patients. The portability of these devices, in compliance with Canadian regulations, may improve access to oral care which is crucial for a more equitable system.

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CONFLICTS OF INTEREST

The authors have declared no conflicts of interest.

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