Bringing X-ray to the Chairside:
The Portable Imaging Advantage in Dentistry

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Many dental offices throughout Missouri have incorporated handheld portable x-ray units into their practices, which have been on the market in America since 2006. Portable units are an excellent option in a variety of situations:

- when wall-mounted units fail and need replacement;
- in new construction where in-wall wiring and pass-through cabinetry are not desired;
- for patient loads that are geared toward pediatric, challenging or elderly patients where it is beneficial to have the operator remaining in the room; and,
- for surgical procedures where a quick image is needed.

Additionally, dentists who practice in sites away from the office, such as humanitarian missions or events, find this device an invaluable tool.

The units' advantages are that they are lightweight, rechargeable and can be shared between multiple rooms in a practice. However, if the device is dropped or damaged, it must be sent in for repair — and if the office does not have a secondary backup unit, imaging will be halted. Some companies will provide a loaner unit to the practice free of charge. Also, the internal battery must be kept charged, as no radiation exposure will be possible without it; many brands take approximately three hours to charge fully.

DESIGN & SPECIFICATIONS

All handheld units have a leaded acrylic circular backscatter shield located at the end of the cone, typically 0.5 mm lead equivalent, to protect the operator's hands and body from scattered radiation from the patient. This backscatter device must remain in place at all times and is usually permanently affixed to the portable unit by the manufacturer.[1,2] While many x-ray photons are absorbed by the patient or reach the sensor contributing to the image, some x-rays will interact with the patient's body, change direction and exit the patient in all directions, resulting in scattered radiation. Handheld devices are also enclosed in lead housing to block leakage radiation from the x-ray tube for the user's protection. Portable units also can be purchased with an associated tripod or stand and exposure switch, where the operator can leave the room or distance themselves from the imaging equipment. This setup is not typically practiced in the United States.

Technical exposure parameters utilized are similar to those of wall-mounted intraoral units. The kV and mA are fixed, generally ranging from 60-65 kVp and 2-2.5 mA with high-frequency x-ray production generators. The user only needs to select the exposure time, which with digital sensors is quite low; settings between 0.15-0.3 seconds can be used for excellent image quality. Short exposure times are always beneficial in any type of intraoral imaging to reduce artifact motion on the image and patient dose. Each type usually offers both child and adult modes with preset techniques to select for specific teeth that are imaged. A full mouth series can be obtained efficiently without delays, as these units cool down fairly quickly between exposures.

Not all handheld units are FDA-approved or authorized for use by the Missouri Radiation Control Program (MRCP) — in fact, multiple units manufactured overseas are considered illegal in Missouri.[2] Three of the approved manufacturers and models most utilized in Missouri will be discussed, with their features and differences observed.

Figure 1

THE DEXIS UNIT: NOMAD PRO 2

Dexis states that they are the first handheld unit on the market, and in fact, many portable units are collectively called 'Nomads', even though this brand is truly the only Nomad. Aribex, followed by Kavo, manufactured this device prior to Dexis. Resembling a hairdryer or power drill, the Nomad Pro 2 is probably the most widely recognized portable dental x-ray machine on the market (Figure 1).

The unit features a detachable handset that houses the exposure trigger and the rechargeable battery. When purchased new from the vendor, a second handset is included so that a charged handset is always available. It is recommended to switch between the handsets after charging to prolong battery life. Dexis estimates that 300-600 exposures can be made on a fully charged handset.[3] These handsets do have a limited life with regard to being charged, and new handsets will need to be purchased over time — typically every two to three years if 7,200 exposures per year are made.

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A protective cover that surrounds the housing is also available for the Nomad, which can guard it somewhat from the occasional daily bumps in the office. This unit is manufactured in America and weighs 6 pounds with a 60 mm round x-ray field,[3] which is the same standard size opening as a typical wall-mounted x-ray unit.

THE DIGITAL DOC UNIT: XTG MINIX-S

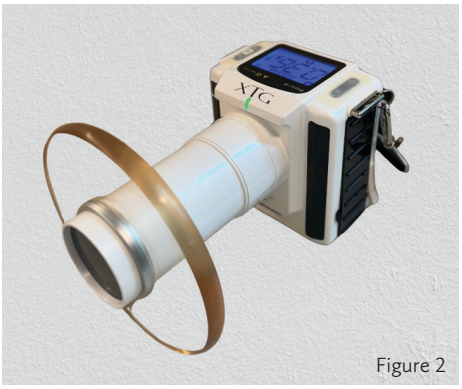

Figure 2

Manufactured by DigiMed Co., this handheld device resembles a large camera with a zoom lens (Figure 2). A neck strap is provided with the unit to ensure the operator does not drop it and to secure the apparatus between images easily. An advantage to the Digital Doc portable is that arm fatigue is minimized because two hands are used for operation. There is a handle present on the right side of the device near the exposure button for a secure hold. The battery is contained within the unit, so the charging cord is plugged directly into the side of the base. This manufacturer states that approximately 150-200 exposures can be made on a fully charged battery; the lifespan of a battery is about two years, which can be replaced on site.[5] The Digital Doc device is manufactured in South Korea and weighs 3.9 pounds with a 53 mm round imaging x-ray field.[5]

THE VATECH UNIT: VEX P300/EZRAY AIR PORTABLE

The Vatech portable dental x-ray device is similar in style to the Dexis Nomad unit and came to the market in 2020 (Figure 3). Many practices that purchase Vatech cone beam CT units will also find themselves new owners of a handheld unit. Instead of the top-mounted control panel, the selections for patient size and exposure time are set using a dial-style system on the end of the device that faces the user. Similar to the Digital Doc XTG, it has an internal battery and does not require a separately charged handset. Manufactured in South Korea, Vatech does not repair these units and will overnight a new device to the dental office if the portable becomes non-operational. Vatech states that 1,000 exposures are possible on a full battery before charging is needed.[6] The battery in the device can also be replaced on site. This unit weighs 4.7 pounds with a 60 mm round x-ray field.

Figure 3

RADIATION SAFETY & DOSIMETRY

The National Council on Radiation Protection and Measurements (NCRP) is the organization that provides recommendations for all x-ray machine usage, including dental devices. Approved handheld dental units are considered very safe for patients and the operator in the dental setting. According to NCRP Report No. 177, the operator does not need to wear a lead apron when using handheld x-ray units due to the backscatter shield providing sufficient protection.[1] The minimum requirement for the acrylic shield is 0.25 mm Pb equivalent;[1] the devices discussed in this article have 0.5 mm Pb equivalent for the operator's protection.

The manufacturers recommend that dental offices follow state guidelines for shielding the equipment user but that generally the operator does not need to wear a lead apron if proper technique is utilized; the user should stand directly behind the backscatter shield with elbows tucked in and the device held away from the body in the protection zone.[3-6] The backscatter protection zone is approximately 2 feet wide X 6 feet high (Figure 4).[3]

The NCRP and manufacturers recommend that pregnant workers wear an apron for optimal protection; however, the MRCP

Figure 4, Image property of Dexis

guidelines recommend all users wear aprons during operation.[2] It should be noted that new shielding recommendations from the American Dental Association and the American Academy of Oral and Maxillofacial Radiology do not require any patient shielding, regardless of age.[7,8]

Personnel dosimetry when using these devices is recommended by the NCRP and MRCP.[1,2,9] Due to the low radiation output in dentistry x-ray devices, many offices in Missouri do not have dosimetry programs in place. If a worker is likely to be exposed to an excess of 100 mrem (1 mSv) in one year, then dosimetry is recommended.[1] It is advised that offices with handheld x-ray devices utilize a dosimetry program for one year; if no readings are detected, the monitoring program may be discontinued.[1,9] Both the ADA and NCRP recommend that all pregnant users notify their employer as soon as they become aware of the pregnancy and that they wear an x-ray dosimetry badge throughout the pregnancy.[1,10]

All new portable dental x-ray equipment purchased in Missouri must be surveyed within 90 days by a qualified expert. If the unit is transferred to another site, it must be reported to the MRCP and surveyed at the new location as well.

SUMMARY

Users of portable dental x-ray equipment can expect the same image quality as wall-mounted unit radiographs. They are easily utilized between several operatories and can increase efficiency and workflow in busy practices. Pediatric or anxious patients may feel safer with the dental operator in the room while they are being imaged; the operator can also be assured that the patient

is not moving during the exam, which would require repeat imaging due to motion. These units are considered safe if the backscatter shield remains in place and the operator has been properly trained. Handheld x-ray units represent a practical, efficient and modern solution in today's dental practices.

Stephanie Patrick, BS, RT (R)(M)(QM) is a Qualified Expert and travels throughout Missouri performing radiation safety inspections for various types of sites including dental. She has been in the radiologic sciences with experience in radiation physics and safety for more than 30 years and enjoys providing educational radiology information to facilities. Contact her at stephpatrickh3@gmail.com. Images are the property of the author except where noted.

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Radiation Shielding Questions Continue

Answered by STEPHANIE PATRICK

QUESTION: In the Winter 2023 *Focus*, the article "To Shield or Not to Shield?" states the Missouri Radiation Control Program (MRCP) adheres to the recommendations of the National Council on Radiation Protection and Measurements (NCRP) and cited the most recent NCRP publication (Report No. 177), which states that aprons are to be discontinued but thyroid shields are to be utilized. However, the American Academy of Oral & Maxillofacial Radiology (AAOMR) recommends both apron and thyroid shielding be discontinued. I'm seeking clarification on the current Missouri guidelines and recommendations.

The MRCP follows the recommendations of the NCRP. Due to this known conflict in recommendations by two national groups, I have repeatedly checked with the NCRP for updates, but there are no additional clarifications published yet. In my most recent contact with them, they stated they have a draft of updated recommendations in place, but it is in review and not published. According to their website, the NCRP has formed a committee to review the current patient shielding recommendations in all areas of radiology, including dental, which could be why it's taking so long to finalize. The commentary information is currently out for review by experts and then must be approved by the council before publishing. There was no date provided for the expected publication at this time, but you can read more here: bit.ly/3KbLq8h. Access the referenced *Focus* article here: bit.ly/4gpJWDw.

QUESTION: Our team wants to ensure we are following the best practices for tracking our annual radiation levels in compliance with state and federal safety guidelines. Specifically, 1) What is the recommended process and frequency for monitoring annual occupational radiation exposure in a dental setting? 2) Are there any state-recommended or approved vendors for personal dosimeter services? Currently we use Instadose but have found communication barriers in understanding our report/deep dose reading/annual allowed limits. 3) Does Missouri offer any free local programs for radiation exposure testing and monitoring?

1) Most offices (if they choose to have monitoring badges) replace them quarterly. That is personally what our medical physics company does, and I survey a lot of dental units along with veterinary offices, hospitals and fluoroscopy units, which are much higher radiation output. 2) The state doesn't recommend any vendors, but popular ones are Landauer, Mirion and ThermoScientific. Those are probably the most popular dosimetry companies in the industry, but there are many other choices. 3) There are no free programs for testing that I am aware of.

When a QE inspects your pano or CBCT unit, a scatter survey is usually taken in the surrounding areas in addition to measuring the exposure parameters of the x-ray unit. For wall-mounted intraoral units, the operator is out of the room. For handheld units, the operator is shielded with the circular backscatter shield if the unit is being used properly. Dental exposure is quite low compared to general radiography. Go to bit.ly/3K8Hcyj to download the American College of Radiology's radiation dose reference chart. General guidelines for radiation badge monitoring from the MRCP are here: bit.ly/4n1UH1i. Some dental facilities are monitoring their exposure, and many are not. If you are likely to be exposed to 100 mrem per year, badging is recommended. If you have a pregnant worker, you can also purchase a dosimetry badge for that staff member for the gestation, and their badge is turned in monthly.