The Radiology Decision

Robert P. Scholz

This article discusses the many issues that should be considered if an orthodontic practice is considering changing from the film platform for radiography to a digital format. As cone beam use increases and its technology improves, one may consider continuing to use film, moving to a 2-dimensional system, or considering a cone beam computed tomography (CBCT) system. Decisions regarding the routine use of CBCT in the orthodontic office are discussed here, as well questions regarding technology selections and their advantages and disadvantages. A radiation dose chart is included as is a desired feature list for CBCT. (Semin Orthod 2011;17:15-19.) © ***2011 Elsevier Inc. All rights reserved.***

The authors of a recent survey[1] have reported that 36% of orthodontists in the United States and Canada have changed from film to one of the digital systems, leaving 64% of orthodontic clinicians continuing to use film. The questions facing those in the latter group are as follows:

- Should the use of film be continued?
- Should one change to an indirect (phosphor sensor) system?
- Should one purchase one of the direct 2-dimensional machines?
- Should the clinician go from what is presently being used directly to cone beam images, either by outsourcing to cone beam computed tomography (CBCT) providers or by personally purchasing a CBCT system?

In deliberating these questions, there is need to consider how a new system will affect office efficiency, patient flow, staff job descriptions, and economics. Factors to consider might include maintaining the film system because it is inexpensive, it is effective, and the clinician is satisfied with showing films to the patients/parents on a light box, or alternatively has time to scan the radiographs into the office's computer network. This approach will also eliminate the additional learning and training associated with change. However, if the existing hardware is aging, there is a risk of having to replace a part that may be expensive and, for a very old machine, not available. However, it will be necessary to trust the system or have a backup plan in place so that if radiographs cannot be taken for those patients who are scheduled, a remedy will be in place until the problem has been solved. Possible long-term solutions include purchasing a 2D direct system, a previously owned film machine, or the commercial "Panoramic Deal," which involves installing a new film machine at no cost and paying a per-film fee (http://www.pancorp.com/).

Some might consider one of the indirect (phosphor sensor) systems, but this choice is reasonable only if the current panoramic/cephalometric (pan/ceph) hardware is in good order and has considerable remaining life. To have purchased one of these systems only to have to replace a very expensive part on an old pan/ceph machine is inadvisable because the money invested would be close to having purchased a direct 2D system. This approach will substitute sensor scanning time for film processing time, which may save time depending on the system chosen. It will also eliminate the darkroom and any time previously used to scan films into the network and the cost will be less than a direct 2D system. Most indirect systems claim a reduction in radiation exposure but this author's experi-

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ence has found it to be close to the exposures required for film.

The 2D direct choice is for those who want maximum efficiency, rapid image acquisition time (most are at 20 s at present), and are willing to spend some money. The darkroom is no longer required, and maximum efficiency with this approach is obtained. Because the author has not used all the available systems, it is not appropriate to recommend one over the other. Cost and local product support are important as are recommendations from colleagues using a particular system. Personal review of the system and having a staff member assess the "user-friendliness" by actual use of the machine and assessing image quality is advised.

The first CBCT system was installed at Loma Linda University in 2001, and it has been reported that there were 1000 installations in 2007 and that number doubled by the end of 2008 (personal communication, Dr James Mah). In 2003 one could find 9 articles on cone beam in the PubMed library; by 2008, that number had grown to 40. Clearly, the use of 3-dimensional radiography has had an impact on the orthodontic specialty greatly, has created many controversial issues, and will continue to affect orthodontics and how decisions are made.

Historically, an orthodontist using a film-based system who desired to upgrade had only to choose between keeping the existing hardware and purchasing an indirect (phosphor sensor) system or spending more money and selecting a direct 2D system. Currently, the decision is more difficult, with the addition of cone beam systems joining the decision-making process. The decision as to whether the clinician should discontinue with film and purchase a 2D system or pass it over and select a cone beam system becomes pertinent. Previously, clinicians in most locations purchased their own in-office system for patient convenience. However, because of the cost of cone beam systems, there has been a new approach with the creation of many digital laboratories to which an office can outsource this task.

Several decisions need to be made. The first decision is how many patients in the practice will require a cone beam exposure at the beginning, during, or after their treatment. This presents a problem if it is currently considered that the use of a cone beam exposure will be used on only a few select patients, but as technology evolves and more studies are completed it is decided to use CBCT on all new patients. Once a decision has been made to use CBCT on all new patients and a CBCT laboratory is not easily accessible, the orthodontist might be inclined to install an in-office system.

Patient Selection for CBCT

The main argument for not using CBCT on all new patients is the additional radiation compared with film exposures and the lack of additional findings one might see with 3D imaging. An editorial by Turpin,[2] former Editor of the *American Journal of Orthodontics and Dentofacial Orthopedics*, describes a recent British report suggesting that we should not cone beam all our starts.[2] Most clinicians will want a cone beam exposure for a case involving impactions, missing teeth, or supernumeraries. However, the list for whom cone beam should be used is growing mainly as the result of claims that the additional information rendered with a cone beam exposure has diagnostic value. Cha et al[3] state that there may be incidental findings of diagnostic value in 26% of new patients if the cone beam is used. In addition, the author can name at least 12 orthodontic programs that use CBCT on all their new starting patients and, having visited many orthodontic programs, can anecdotally state that many resident research projects are focused on cone beam issues. The author also knows several orthodontic colleagues who own a cone beam system and are using it on every patient they start. With this volume of cone beams being taken, research will continue to be forthcoming. As more is learned, it is likely that increasing numbers of orthodontists will be led to use 3D imaging.

Radiation Dosage

Orthodontists should be aware that there is a perceived concern from patients and referring colleagues regarding the additional radiation compared with film exposures. This has been a controversial issue for some time because it has been difficult to make appropriate comparisons. First it must be known how much radiation patients are receiving from the cone beam system (and different systems emit vari-