

Survey of terminology used for the intraoperative direction of C-arm fluoroscopy

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Accepted for publication
Sept. 6, 2011

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DOI: 10.1503/cjs.015311

Background: Orthopedic surgeons depend on the intraoperative use of fluoroscopy to facilitate procedures across all subspecialties. The versatility of the C-arm fluoroscope allows acquisition of nearly any radiographic view. This versatility, however, creates the opportunity for difficulty in communication between surgeon and radiation technologist. Poor communication leads to delays, frustration and increased exposure to ionizing radiation. There is currently no standard terminology employed by surgeons and technologists with regards to direction of the fluoroscope.

Methods: The investigation consisted of a web-based survey in 2 parts. Part 1 was administered to the membership of the Canadian Orthopedic Association, part 2 to the membership of the Canadian Association of Medical Radiation Technologists. The survey consisted of open-ended or multiple-choice questions examining experience with the C-arm fluoroscope and the terminology preferred by both orthopedic surgeons and radiation technologists.

Results: The survey revealed tremendous inconsistency in language used by orthopedic surgeons and radiation technologists. It also revealed that many radiation technologists were inexperienced in operating the fluoroscope.

Conclusion: Adoption of a common language has been demonstrated to increase efficiency in performing defined tasks with the fluoroscope. We offer a potential system to facilitate communication based on current terminology used among Canadian orthopedic surgeons and radiation technologists.

Contexte : Peu importe leur subsécialité, les chirurgiens orthopédistes ont besoin de la fluoroscopie peropératoire pour guider les interventions. La polyvalence du fluoroscope à bras en C permet l'acquisition de n'importe quelle image radiographique ou presque. Cette polyvalence comporte toutefois son lot de problèmes de communication entre le chirurgien et le technologue en radiation médicale. Or, une piètre communication va de pair avec des retards, de la frustration et une exposition plus longue aux rayons ionisants. Actuellement, les chirurgiens et les technologues en radiation médicale n'utilisent pas une terminologie standardisée pour désigner l'orientation du fluoroscope.

Méthodes : L'étude a reposé sur un questionnaire administré en 2 parties sur Internet. La partie 1 s'adressait aux membres de l'Association canadienne d'orthopédie et la partie 2, aux membres de l'Association canadienne des technologues en radiation médicale. Le sondage était composé de questions ouvertes ou à choix multiples et portait sur l'expérience des répondants avec le fluoroscope à bras en C et la terminologie préférée des chirurgiens orthopédistes et des technologues en radiation médicale.

Résultats : Le sondage a révélé un écart considérable entre les termes utilisés par les chirurgiens orthopédistes et les technologues en radiation médicale. Il a en outre montré que l'expérience de nombreux technologues en radiation médicale laissait à désirer en ce qui concerne le maniement du fluoroscope.

Conclusion : On a démontré que l'adoption d'une terminologie commune améliore l'efficacité de réalisation de certaines tâches précises avec le fluoroscope. Pour faciliter la communication, nous proposons un système fondé sur la terminologie actuelle utilisée par les chirurgiens orthopédistes et les technologues en radiation médicale du Canada.

As orthopedic surgery trends toward increased use of percutaneous or less invasive techniques, our dependence on intraoperative fluoroscopy increases.¹ Modern C-arm fluoroscopy is a versatile tool that facilitates the visualization necessary for orthopedic procedures from fracture reduction and instrumentation to foreign body removal, spanning all subspecialty areas.

Most modern C-arm fluoroscopes are capable of 12 distinct motions. This versatility allows acquisition of almost any view of the desired anatomy, but also creates confusion between the surgeon and radiation technologist when communicating the desired positioning of the fluoroscope. Poor communication leads to frustration on the part of both the surgeon and technologist and has been recognized as a barrier to teamwork and a source of conflict, inefficiency and potential error.²⁻⁴ One must also remain conscious of the use of ionizing radiation. Poor communication between the surgeon and radiation technologist may increase exposure of the patient and the surgical team. C-arm fluoroscopy exposes the patient to 1200–4000 mrem/min. Recommended annual limits of radiation are 5000 mrem for the torso and 50 000 mrem for the hands.¹ Locked intramedullary nailing of a femoral fracture required an average of 6.26 minutes of fluoroscopy time in a previously published series.⁵

Currently, no consistent and widely used set of terms exists to facilitate communication regarding positioning of the fluoroscope. In the absence of an experienced surgeon/technologist team, or in the instance of an unusual case, this results in a learning curve wherein the surgeon and technologist must attempt to translate the language of the other. This process is inevitably slow and inaccurate. Frustration has been shown to be increased both by delay in acquiring what one desires, and by judgement that upon acquisition it was not worth the wait.⁶ This can be appreciated in the context of waiting for an image to be obtained only to judge it inadequate. A recent study demonstrated that a prearranged communication strategy between the surgeon and radiation technologist reduced the time required to perform a number of manoeuvres with the C-arm fluoroscope in an *in vitro* experimental scenario.⁷ A consistent, widely used set of terms understood by both the surgeon and technologist might facilitate faster acquisition of quality images, thereby decreasing frustration and exposure of the patient and surgical team to ionizing radiation.

The purpose of our investigation was to define current terminology for directing the movement of the C-arm fluoroscope among orthopedic surgeons with various subspecialties and experience levels and to determine what terminology is preferred by medical radiation technologists.

METHODS

In part 1 of the investigation, we distributed a web-based survey to members of the Canadian Orthopedic Association (COA) in December 2009. The survey consisted of 12 open-ended questions illustrating each of the possible distinct motions of the C-arm fluoroscope and asking respondents how they would ask the technologist to perform each manoeuvre. The survey also asked how re-

spondents would ask for a single image or a live image and requested information about respondents' practices and level of experience.

We then collated responses into like groups based on terms of reference (e.g., me, you, ceiling, head), direction (e.g., forward, back), action (e.g., tilt, swivel, turn) and special instructions (e.g., specific levers, locking base).

In part 2 of the investigation, we modified the survey from open-ended questions to multiple-choice questions. The stems were chosen based chiefly on the most frequent responses from part 1. This survey was then administered, again in a web-based format, to the members of the Canadian Association of Medical Radiation Technologists (CAMRT).

RESULTS

Part one

The survey was distributed to 1213 COA members, 261 (21.5%) of whom responded. Respondents included COA members from all Canadian provinces and 1 territory as well as 26 members practising in the United States. Respondents represented every level of experience and subspecialty area in orthopedics (Fig. 1).

Respondents described how they would ask the operator of the C-arm fluoroscope to perform each of 12 distinct motions demonstrated in illustrations. We found the terminology used to direct the fluoroscope to be tremendously diverse. In many instances, identical language was used by different respondents to indicate different manoeuvres. An example of responses is presented in Figure 2. Particularly ambiguous terms included "up," which was used to describe both a direct vertical elevation and a movement toward the head of the patient/bed. Terms used to ask for the 3 nonlinear motions of the fluoroscope were particularly diverse. The terms "rotate," "tilt" and "angle"

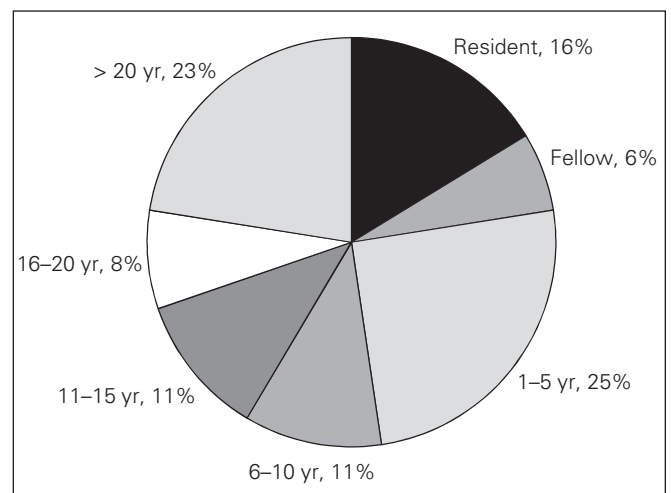


Fig. 1. Survey respondents' level of experience.

were each used interchangeably to describe any of the rotational actions of the fluoroscope.

Part two

In this portion of the investigation, we used the most frequent answers of the COA respondents to create a multiple-choice survey that was distributed to the more than 8000 CAMRT members. The 225 (2.8%) respondents represented all 10 Canadian provinces. Half had been working as a medical radiation technologist for fewer than 10 years. Notably only 4.4% of respondents spent more than half of their time at work operating a C-arm fluoroscope in the operating room (Fig. 3). When asked what terminology they preferred when receiving direction from a surgeon, few clear favourites were identified.

DISCUSSION

The results of the 2 surveys illustrate a situation in which many radiation technologists spend little time in the operating room operating the fluoroscope. One should not be

surprised that a technologist whose time is distributed among many surgeons performing diverse procedures might not be familiar with every specific procedure. In addition, the terminology used by orthopedic surgeons to direct the fluoroscope is tremendously diverse and often ambiguous. The language emphatically used by one surgeon will very likely be different than that forcefully defined by another surgeon in the very next case. Of course, in many instances the technologist and surgeon are both familiar with each other, with the case, with the views required and how they are obtained. In these cases, instructions such as “make the holes round” or “obturator outlet” or “find me the pedicle” are enough. It is in the instances in which the case or view is not familiar or when the image must be fine-tuned that we must be able to communicate.

Unfortunately, defining the ideal system of terms to direct the fluoroscope is not as simple as choosing the most common terms in current usage. Ideally, the terms would be concise and applicable in all orthopedic procedures on the entire skeleton and would not depend on the position of the surgeon, technologist or patient for reference. Likely more important than the details of any specific system is that it is understood by both the surgeon and technologist and used uniformly.

The following is a potential system based in part on the frequency of terms in our survey responses and on the characteristics of a system we thought desirable (Fig. 4).

Each request should begin with a term designating the motion to be performed followed by a numerical descriptor of the distance the C-arm should be moved. One should avoid ambiguous instructions, such as “a little bit.” For the 6 linear motions of the fluoroscope, we suggest a single term to designate the direction followed by a distance in centimetres or inches indicating the desired amplitude of change. For the 6 rotational motions of the

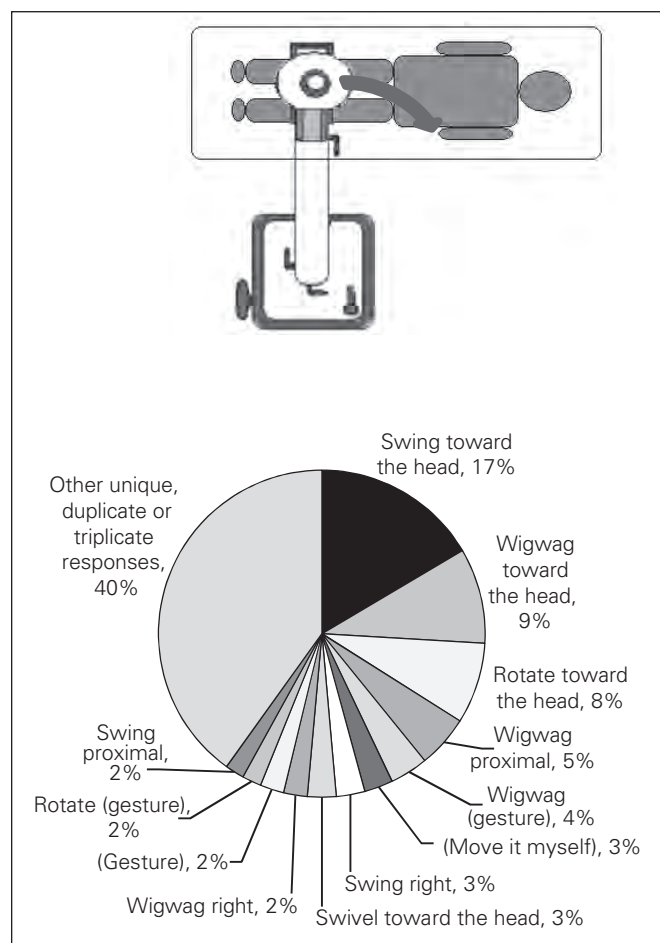


Fig. 2. Summary of responses to the survey question “How would you ask the technician to perform the movement in the above illustration?”

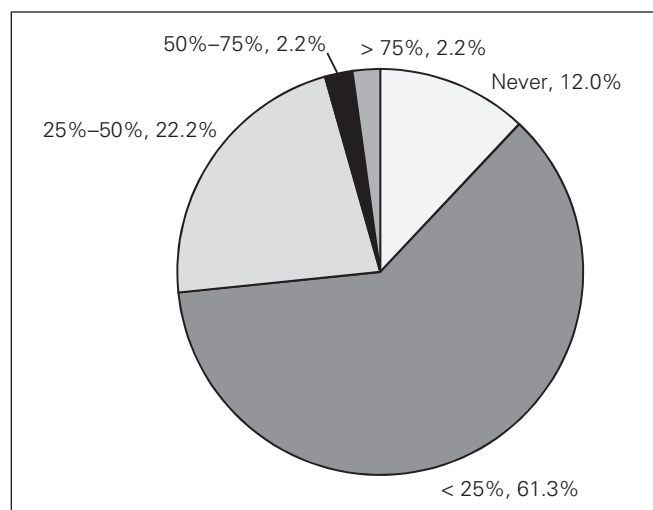


Fig. 3. Summary of responses to the survey question “What portion of your time is spent operating a C-arm fluoroscope?”

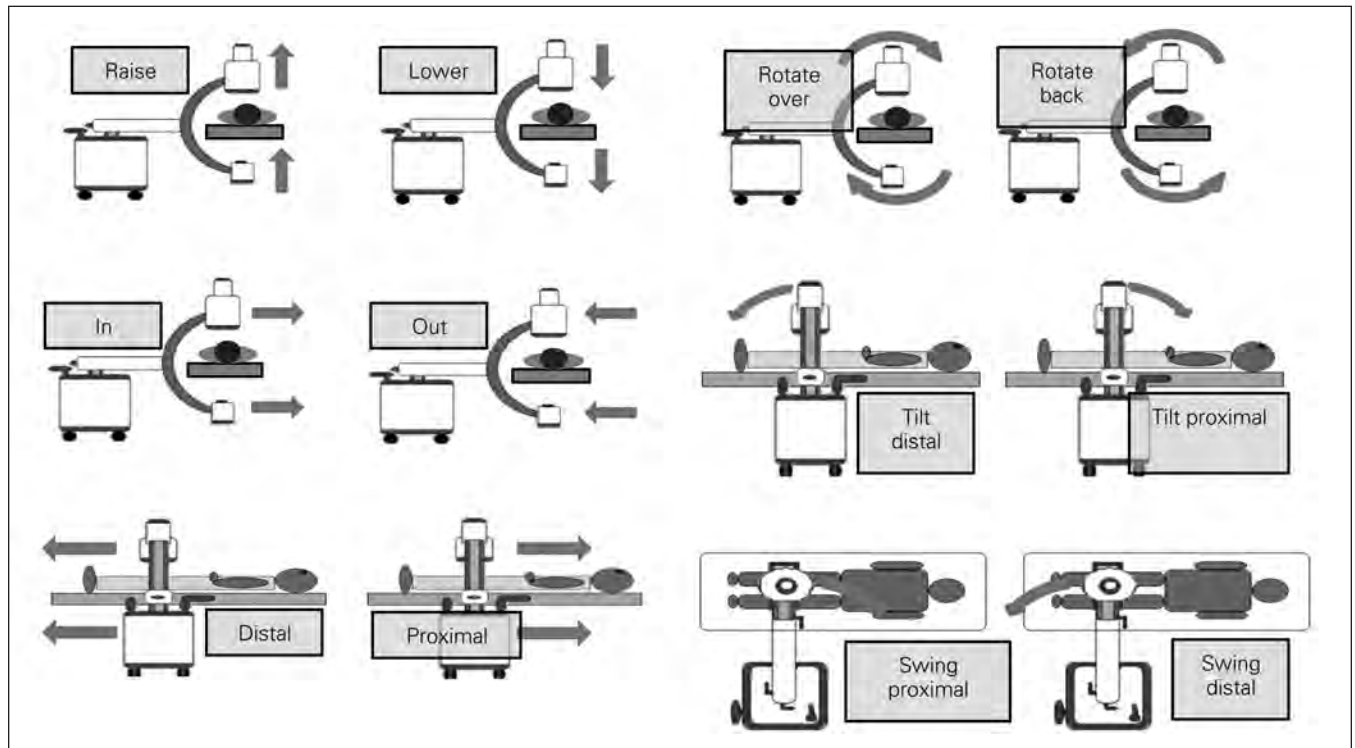


Fig. 4. Suggested terminology.

fluoroscope, 2 terms are required: 1 to designate the motion and 1 to designate the direction. This should be followed by the number of degrees of change that is desired. Most C-arm fluoroscopes are equipped to measure linear and rotational motion or can be modified to do so.

Use of a common language has been demonstrated to improve efficiency in obtaining images with the fluoroscope.⁷ Our investigation illustrates the inconsistency in terminology currently used for direction of the fluoroscope. Coupled with casual use of the fluoroscope by radiation technologists, frustrating miscommunication is inevitable. Adoption of a common terminology would improve communication, potentially shorten surgical durations and reduce exposure to ionizing radiation.

CONCLUSION

Widespread adoption of a common language to direct the fluoroscope will not happen spontaneously. Standardized education of surgical residents and radiation technology students would likely be the most effective method to bring about enduring change. By introducing a standard lexicon early in training, efficient communication would hopefully become an unconscious part of operating the fluoroscope in every case. In addition, if the language were to gain a foothold, this solution would limit the grounds for frustration among nonadopters. First, of course, a common language must be accepted by the educational bodies of those concerned. The proposed system may

prove effective; however, before endorsing any particular lexicon, one might consider pilot projects in which a few sites adopt and formally evaluate the system in practice, such that it might be modified and refined before a final system is chosen. This presents an opportunity for organizations, such as the COA and the CAMRT, to provide leadership in improving communication among professionals in the care of our patients.

Competing interests: None declared.

Contributors: Both authors designed the study, analyzed the data, reviewed the article and approved its publication. E. Pally acquired the data and wrote the article.

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